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DEVOTED TO CIVIL ENGINEERING AND CONTRACTING

E. J. MEHREN *Editor*

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Engineering News-Record is a consolidation of *Engineering News* and *Engineering Record*, effected in 1917.

Engineering News was founded in 1874 by George H. Frost, as the *Engineer and Surveyor*, which title subsequently became the *Engineer, Architect and Surveyor*, then *Engineering News and American Railway Journal* and finally, *Engineering News*, under the successive editorships of D. McN. Stauffer, Arthur M. Wellington and Charles Whiting Baker.

Engineering Record was established in 1877 by Henry C. Meyer as the *Plumber and Sanitary Engineer*. The name was subsequently changed to the *Sanitary Engineer, Engineering and Building Record* and, finally, to *Engineering Record*. During his ownership of the paper, Mr. Meyer was directly responsible for the editorial policy. John M. Goodell became editor in 1902, and was succeeded by E. J. Mehren.

The Contractor was consolidated with *Engineering News-Record* in 1918.

The staff of *Engineering News-Record* consists of

New York: E. J. Mehren, *Editor;* F. C. Wight, *Managing Editor;* M. N. Baker, F. E. Schmitt, R. K. Tomlin, Jr., C. S. Hill, Willard Chevalier and J. W. Shaver.

Chicago: W. W. DeBerard, E. E. R. Tratman.

San Francisco: N. A. Bowers.

The Licensing Issue Reviewed

LICENSING or registration of engineers is now required in nineteen of the states. It is, therefore, for a large number of engineers an accomplished fact, something to be observed in practice rather than to be argued about. Nevertheless, argument continues. Engineering Council's committee only a few weeks ago discussed the matter as though it were still something to be settled. The licensing committee of the American Society of Civil Engineers, which has been sitting for a year, has not yet arrived at any conclusion justifying a report. Clearly the bulk of the profession has not made up its mind on this so important a subject. For this reason we think it worth while to set before our readers elsewhere in this issue some well-stated arguments in favor of licensing by one who has had some experience in administering a license law and an impartial editorial analysis of the licensing question, which it is hoped will help to clarify the issue in the mind of the engineer who is considering it.

Where Posterity Can Read It

IT WAS well said at last week's dinner in honor of J. Waldo Smith that he has indelibly written his name into the annals of New York and into the records of great American engineering achievements. Even the general public today reads with interest of the leaden pipe distribution systems and the aqueducts of ancient Rome. Shall not the people several centuries hence point to the Catskill Aqueduct as one of the essential factors in permitting the tremendous growth of the metropolitan city of this continent. They of that time will probably have even more stupendous works, but will they not look back, as we do now to the aqueduct builders of ancient Rome, with reverence to then man who had the vision and the engineering ability to put through the greatest aqueduct of his time? Fundamentally there is but little change in the human race over the centuries. Human impulses will probably be basically the same in the year 2500 as they are today and, if they are, the achievements of J. Waldo Smith will still be inspiring, will still be a tribute to the might of the man who, with machinery inadequate as measured by the developments of the year A.D. 2500, builded structures that supplied the water needs of New York's millions.

The Milk of Human Kindness

CELEBRATIONS of the kind referred to in the previous note are not unusual. Nevertheless we never assist at a function in honor of the achievement or retirement of some important man without feeling that we do not often enough express our appreciation of those who have done well by their fellows or by the public. We forget that it is far better to pin a single rose on a man's coat than to put a bushel of them on his coffin. Such functions—dinners we mean, not funerals—are good for the recipient of the honor. They show him that beneath the formal business exterior of his associates is a warm human heart. They cheer him up. They send him on with new vigor and furnish memories that are a solace in the days of reminiscence. But these functions are equally beneficial to those who participate in the rendering of the honor. To them such affairs are an inspiration to higher endeavor. They are evidence of the reward that comes to those who have served well their fellow men. They give occasion to reflect upon those human qualities which must be added to sheer intellectual ability if one is to achieve a worth-while success in this our world. Let us have more dinners or other celebrations that put a human note into our business and professional occupations.

Defining the Issue

CHAIRMAN HOOPER of the Railroad Labor Board scores a bulls-eye in his statement that "the people of the United States are sick and tired of having railway transportation and traffic periodically interrupted by controversies between railway managements and employees." The Labor Board itself is the tangible evidence not only of that state of disgust but also of their determination that in the settlement of such controversies the rule of reason must prevail. Since its establishment the authority of the Board has been invoked on several occasions, both by the managements and by the employees, to the incalculable advantage of all parties at interest, including the public. We have

made progress; there must be no retreat. The present attack on the board is more than an industrial incident, more than a matter of wages, hours or working conditions. It is not a "strike" or a "walkout" at all. It is a gesture of defiance toward an arm of the government lawfully exercising its authority in the public interest. No greater disservice to the members of the shop crafts unions could be performed by their leaders than to flout the American people with regard to this issue. They are too determined; they have come too far. We suggest that the "Little Six" hesitate long before rushing in where the "Big Four" feared to tread last October.

Mt. Everest Named for an Engineer

APROPOS the expedition struggling to scale Mount Everest, engineers will be interested to know that this, the loftiest summit on earth, bears the name of an engineer. Sir George Everest spent much of his life on engineering works in India becoming surveyor-general in 1830. In 1841 he completed the trigonometrical survey of the Himalayas and first determined the position and altitude of the peak that bears his name.

"Selling" Highways to the Public

A NEW phase of the highway problem is assuming importance in the minds of engineers. Until recently chief consideration has been given to financing, design, construction, and maintenance. Now that the state departments have made substantial progress in spinning their traffic webs between important centers to form an interconnected system the problem of operation looms large. For the most part the highway departments have reasoned thus: Our job ends with the construction and maintenance of roads; let the public use them as it will. Today, however, we find certain highway departments—Wisconsin is an example—going a step further, by *selling* its product to the road user. To accomplish this end the Wisconsin department has each year for several years issued an excellent map of the state trunk highway system. The latest edition contains forty-eight pages folded to a convenient pocket size. There is shown first a key map of the entire state, followed by maps, on a larger scale, of different sections. All routes are numbered and the condition and surfacing are indicated in every case by the use of different conventions, red, black, and purple ink being employed. In addition, the maps indicate points of historical, scenic, and industrial interest, camping sites, state parks. There is a real business return for the state in such a publication as this. Increased highway traffic turns revenue not only into the hotels and shops, but into industries of all kinds. In this country the development of tourist traffic as a means of paying indirectly for road construction and maintenance has been almost entirely neglected. Highways can be made to yield dollar-and-cents returns just as surely as does Swiss scenery if the technical conception of them can be leavened by a proper amount of promotional instinct.

Settle the Next Strike Now

AS THIS is written President Harding is assembling in Washington representatives of both parties to the coal strike. It is to be hoped, of course, that this conference will bring about a resumption of coal mining, for the country now stands face to face with the long-expected shortage. The wish of the President, we are told, is to have the operators and miners work out their own settlement. The government wishes neither to use compulsion nor to enter the coal business. All this is worth while, so far as it goes. But we cannot quite see how mere composition of the present differences can lead to any result more far-reaching than a truce. Elsewhere in this issue appears a discussion of the coal industry by George Otis Smith, director of the U. S. Geological Survey. Its problems, as he presents them, are beyond the scope of the present conference. They involve, root and branch, the entire economic organization of the industry; the volume of capital invested, the number of workers dependent on it, the relation between productive capacity and market demands, the buying habits of the people, and the coordination of all these in the general interest. We fear that the statesmanship of operators and miners combined is unequal to the needs of the situation, and that if we are to get anywhere the government must play a part more active than that of the friendly advisor. This does not mean that the government should get into the coal business. It does mean that sooner or later the coal industry complete, from mine to consumer, must be reorganized and that the leadership in this tremendous undertaking must be assumed by some agency with the authority and the resources of the government behind it. We believe that now is the time to put this job in hand and we hope that the President will not be turned aside from it by any disposition to smooth over the present difficulties by leaving the morrow to care for itself.

A Twenty-fifth Anniversary

NEARLY eight hundred engineers and manufacturers gathered at the Atlantic City meeting of the American Society for Testing Materials last week, the twenty-fifth meeting since a small but hopeful group founded the society in 1898. They celebrated a twenty-fifth anniversary—or a twenty-fourth, depending on one's preferences in arithmetic. Within the margin of experimental error, as the testing-laboratory man likes to say, the society can look back on a quarter century of useful existence. That is a proud and justified diversion, and also a salutary one, for societies as for individuals. President Young's review of the career of the society was an instructive retrospect upon a great amount of work well done.

Industry and the general public have been benefited by this work through better regulated production and more assured quality of materials. The engineer, who has benefited fully as much, finds in the society's career a remarkable example of effective group activity, the kind of activity on which much of his daily work depends for its effect. From every point of view the society has achieved success.

In view of this success the reasons why the society came into existence and why it prospered claim attention. A quarter-century back, a few men saw clearly that an essential step in the country's productive processes was unprovided for: the exchange of material between maker and user in mutually satisfactory manner. They reasoned that this step required the work of the engineer, who would use rule and line and testing machine and weighing scales to appraise demand and per-

formance and to harmonize them. They took up this work courageously, even though well-established organizations of engineers had declined to concern themselves with it.

That the purposes of the society are rooted deep in economy and efficiency of production is doubtless a main factor of its consistent success. But a truly democratic system of working and wise and just direction of its functioning played a part. Some of the many societies of more recent creation might fitly test their own prospects for a useful career by comparison.

As to the American Society for Testing Materials itself, now that it is entering on its third dozen of years it has the pleasant privilege of appraising its condition with an eye to its future growth. It is a lusty youth and needs exercise, more exercise than the crowded limits of one meeting a year fairly supplies: a certain lack of vigor in some of the meetings already gives warning that flabbiness of the muscles may supervene. It has made its growth on labor in practical fields, and it must stick to work of real utility: The danger of drifting off into the extreme or the fanciful, of trying to draft specifications for Ground and Polished House Numbers (Grades A and B) for Families of Moderate Income, for example, is worth keeping in view. Simple principles and purposes and the sanity of common sense will keep it sound.

But along with practical work the society now needs to do some thinking—study and research work, for which there has been little leisure in the past. A serious-minded beginning in this direction has already been made, and with a research man as new head of the society the efforts in this direction are sure to receive well-merited encouragement.

The big opportunity which the immediate future holds out to the American Society for Testing Materials —so it seems to us—lie in intellectual growth. If this opportunity is taken, a real science of materials can be created, to fertilize the soil from which spring our practical arts of production and engineering.

Water Power Auxiliary to Steam

HYDRO-ELECTRIC power in its earlier days was used mainly to supply the needs of a given market. Sometimes, especially in the West and South, such development constituted the first central station power supply available to a market. In other cases, especially in the East, the aim was to supersede steam central stations by the output of hydro-electric plants, either because the former were more antiquated and inefficient or because of high cost of fuel. Steam plants where built or retained in connection with water power were auxiliary to that power, either acting as a "stand-by," to insure reliability of service because of real or fancied shortcomings of the older transmission lines, or to supplement the output of hydro plants during periods of deficiencies in stream flow. This phase of water power development is changing in the sections of the country where coal is available and a situation has arisen where frequently water power to be considered at all must be thought of only as an auxiliary to steam.

The use of hydro-electric power primarily to reduce the fuel and labor bills of a power system is common enough. From the standpoint of hydro operation the requisite is merely to utilize the stream flow to the greatest extent, allowing a minimum to be wasted over the spillway. On the other hand, the best interests of the entire system require taking into account the characteristics of the steam-electric units, giving each as uniform a load as possible and a high capacity factor. There must also be taken into account the load characteristics of the system, for the hydro power can be utilized only when the market can absorb the energy. For this purpose pondage for daily regulation of flow is important, especially upon the larger streams.

The possibilities of using hydro power for peak-carrying purposes are not so well appreciated. Susquehanna River power from the plant at Holtwood, Pa., is used during low-water periods to "iron out" the peaks on the steam electric plants of the Baltimore market. The report of the Superpower Survey of 1921, covering the Boston-Washington territory, sets forth in general terms the advantages of using hydro plants for carrying the peaks of the combined systems. But the fact is that present day development has hardly scratched the surface of the possibilities of using water power for this purpose.

One of the outstanding facts is the very low load factor of the top load as one may style the uppermost part of the peak load of a power system. In a typical load of 100,000 kw., with an annual load factor of about 50 per cent, the load factor of the top load of 20,000 kw. rarely exceeds 10 per cent. This, in the case of a 20,000 kw. hydro-electric plant, charged with the duty of carrying the corresponding top load of the system, the plant would theoretically require not more than 10 per cent of the quantity of water that would be necessary to generate 10,000 kw. continuously. Actual operating conditions involve a departure from the theoretical, and a safe margin of stream flow or energy must be supplied; but even so the total energy requirement is surprisingly low.

Evidently wonders can be accomplished with relatively low stream flow and limited storage capacity. As a rule the desired results are most economically attained in developments of relatively high head with little or no length of waterway and with short penstocks. The direct type of development, with power plant at a high dam, is best adapted so far as physical conditions are concerned. Naturally, reliability of stream flow and of electrical transmission to the power market are of prime importance wherever the scheme is to be carried to its logical and most desirable development, namely, that of allowing the hydro capacity to be a reliable substitute for additions to the steam-electric capacity of a central station or power system.

There are also business considerations. Obviously, a given hydro-electric possibility may be operated to the best advantage if it is under the same control as the major steam-electric system. Such control may be exercised either by complete ownership or through an operating contract or lease covering the hydro plant.

From this standpoint of reliable peak-carrying capacity many an otherwise unattractive water power can be used advantageously as an auxiliary to a steam-electric system and a more extensive use of hydro-electric power for this purpose appears clearly to be indicated. The economies involved are a most interesting study in themselves, though it might be pointed out that the savings resulting from the use of water power to carry the top of the peak load are dependent primarily on the cost of installing and maintaining steam-electric generating capacity rather than on local cost of fuel.

Removal of Three First-Story Columns in Twenty-Seven Story Building

Transfer of Load Accomplished by Using Cantilever Trusses as Levers — Elastic Distortion of Columns Taken Up By Jacking — Procedure Checked by Strain-Gage Readings

By Edward F. Weiskopf
Engineer with S. C. Weiskopft, Consulting Engineer, New York

IN CONSTRUCTING an addition to the American Telephone and Telegraph Building at Broadway and Fulton St., New York, just completed, some extremely heavy column loads had to be transferred to new columns in order to obtain the desired space arrangement at the connection with the old building. Three columns carrying the side wall and end floor bays for the full height of 27 stories were relieved of their loads at the third-floor level, the 24-story upper sections carried by cantilever trusses in the new building, and the lower sections removed in the first story.

The old building occupies the corner of Broadway and Dey St., with a narrow wing running through to Fulton St. at the middle of the block. The addition is on the Broadway-Fulton St. corner, filling out the rectangle. Together, the old and new structures unite into one finished building covering the whole Broadway block front. As it was desired to have the new building match the old in every detail, the ground floor was carried through both in a lofty hall, 35 ft. high, open in the interior and finished to give the effect of a Greek temple. This effect is produced mainly by 5-ft. marble columns spaced about 17 ft. on centers. In order to carry out this arrangement, three of the old building columns had to be removed in this story.

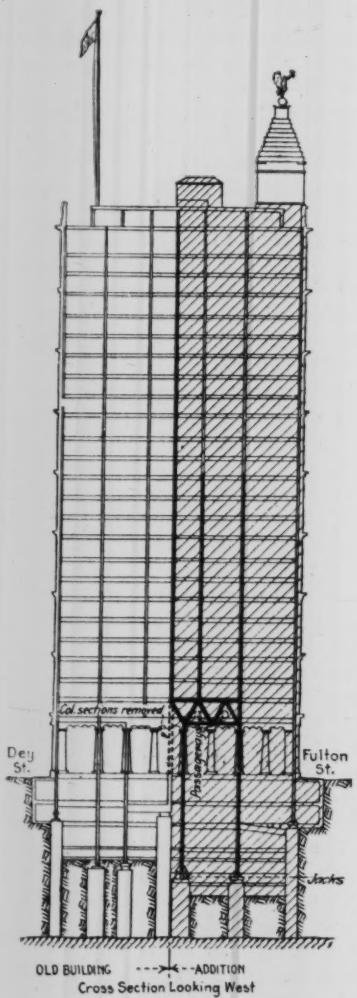
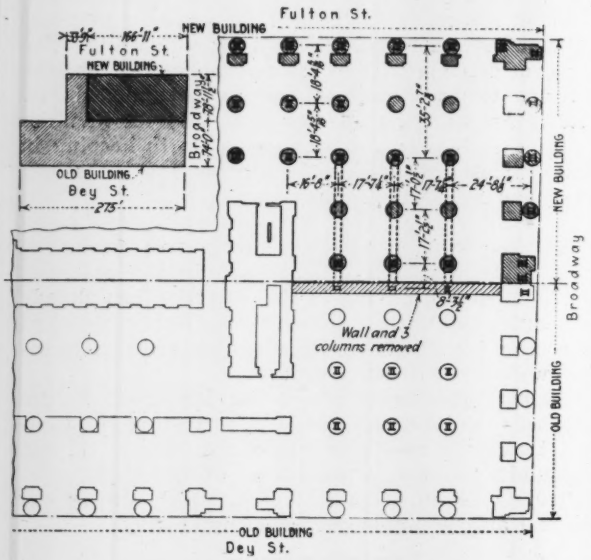


FIG. 1. ADDITION TO A. T. & T. BLDG., NEW YORK; COLUMN LOADS TRANSFERRED BY CANTILEVER TRUSS SYSTEM

These three conflicting columns were in the side wall parallel to Dey St., and, as is seen by the plan, would come at about the middle of a column bay. Before the design was made the owners inquired whether it would be possible to remove these three columns and carry the upper 24 stories while the work was being done. It was decided to be entirely feasible and several schemes were studied.

Choice of Method—In order to arrive at a solution of the problem, only those schemes which would accomplish the transfer of load very gradually, eliminating any



sudden jar, were considered. The scheme of carrying the columns on the ends of three cantilever trusses built as part of the new building was finally adopted. The merits of this scheme in addition to permitting of a very gradual transfer of the load are that it would allow full and undisturbed use of the existing building, a thing that the owners most urgently desired, that it required a minimum of falsework, that it did not involve any dangerous underpinning, and that it was the most economical of all the methods contemplated.

The three columns to be carried were (see framing plan, Fig. 2), Col. 52-A, 471 tons; Col. 56, 1,171 tons; and Col. 60, 1,325 tons, the loads stated being the maximum (dead and live) load at third-floor level. The truss cantilever arms are 8½ ft. long. The trusses were run back two bays, giving a back arm of 34 ft. The main floor column under the middle of the back arm (see section in Fig. 1) is then a dummy. The truss depth, 15 ft. between centers of chords, is slightly greater than the third-story height. Each truss carries one upper floor column located 8½ ft. back of the fulcrum point; it will be seen that the columns in the upper stories in part are offset with respect to the columns below.

When a transfer of loads of such magnitude is to

be undertaken, it is obvious that this transfer should take place very gradually. The most gradual and steady method, and in this case also the simplest, was to use the trusses as levers by letting the anchor end hang free. Then, as the erection proceeded in the new structure, the load of the old columns would automatically be lifted off.

As the column on the truss is located a distance back of the fulcrum point equal to the length of the cantilever arm, and the anchor column (at the end of the back arm) is four times as far away, the relieving of load during the progress of erection proceeded in the ratio of one to one for the truss column and four to one for the anchor column. The maximum load on the cantilever end was of course the full column-schedule load for the column at the third floor. The minimum load was taken as the full dead load plus 15 lb. per sq.ft. live load. It was found that maximum stress occurred in the chord members, the cantilever end post and the adjacent web member when the cantilever end was fully loaded and the back arm fixed. The maximum stress in the rest of the web members occurred when the cantilever arm was fully loaded and the back arm free. All members were checked for maximum and minimum loading with the back arm both fixed and free.

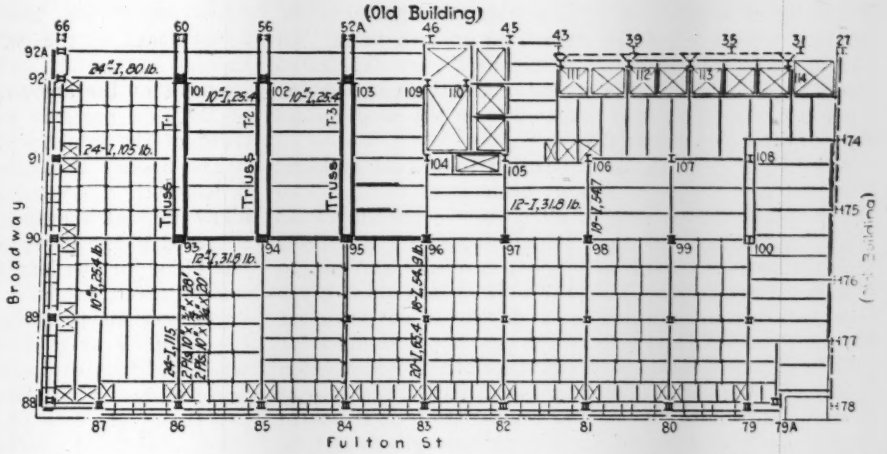


FIG. 2. POSITION OF CANTILEVER TRUSSES IN THIRD-FLOOR FRAMING PLAN

Trusses and Connections—The chord members were made of plate-and-angle double-H section, and the web

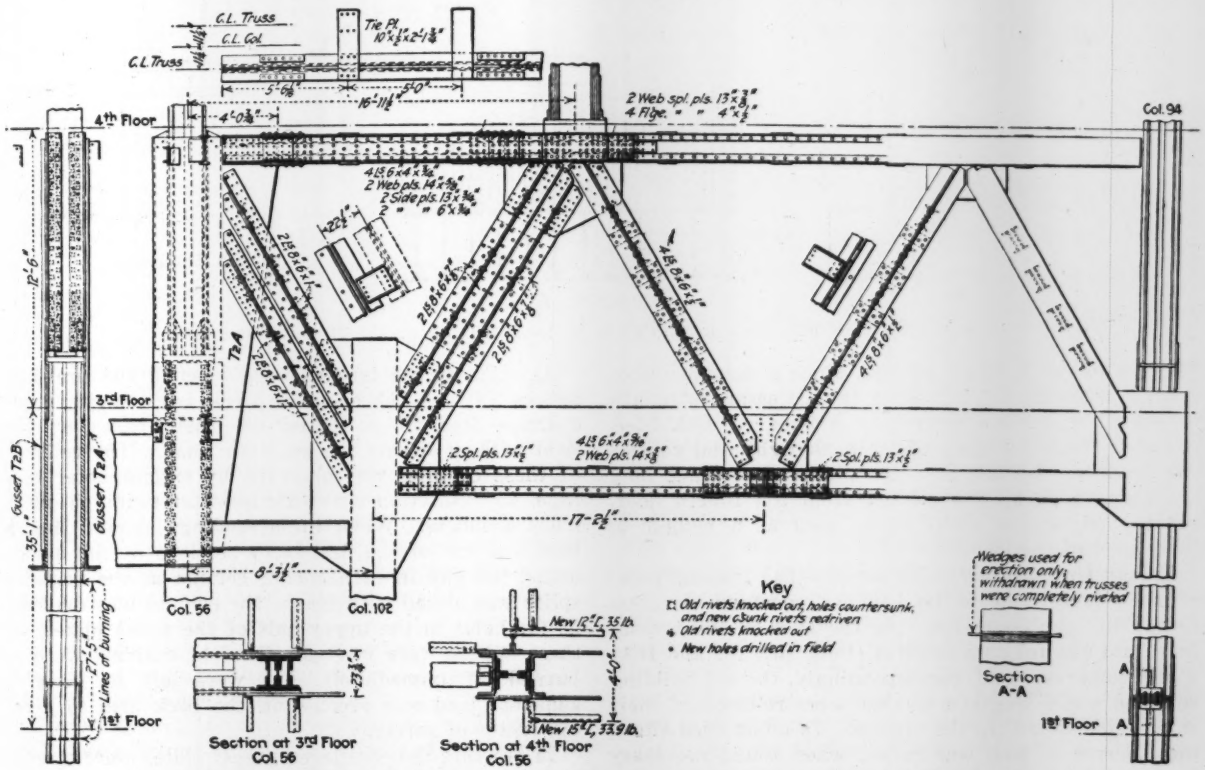


FIG. 3. TRUSS CONSTRUCTION AND TYPICAL HEAVY PANEL-POINT DETAIL

In attaching the large gusset plates to the old column the procedure was as follows: On Face A of Col. 56 the old rivets were replaced one at a time by new ¾-in. rivets countersunk and chipped near side; the two splice angles on southeast corner of column and the splice plate and filler on Face B at 3rd floor were removed; holes were drilled in the new 8 x 8 x ¾ in. angles to match the holes in the column; the angles were placed on the column and the holes reamed to 1 1/16 in.; all remaining holes in angles and column were then drilled 1 1/16 in. The same operations were then repeated on east side of Face C.

On Face B, the top and bottom chord angles of the 3rd floor girders were cut; the rivets were replaced one at a time by new ¾-in. rivets countersunk and chipped near side; the holes in the new gusset plate T2A were drilled 1 1/16 in. as marked, to match holes in the column; the remaining holes in gusset plate and column as marked were drilled 1 1/16 in.; 1-in. rivets above 3rd floor and ¾ in. rivets below splice were driven in all open holes in gusset plate T2A.

The same operations were then repeated on Face D, in order to erect plate T2B

members were made of eight angles arranged in pairs. Two 1¼-in. gusset plates were used at each joint. All truss rivets were 1-in. The members were fabricated from steel templets, the gusset plates being used for this purpose. They were assembled in the shop and all holes reamed to a true fit.

Making the cantilever connection to the old building columns was the most serious problem of detail. Two 1¼-in. plates were used to effect this connection. As these columns had to carry their full load for the whole time it was necessary to proceed carefully and not to cut more rivets than necessary. The procedure given on the erection sheet (Fig. 3) lays this out in great detail. The plates were drilled in the shop with holes for the column connection only, the truss member connection being left plain for fitting in the field. In the case of Column 56, where two girders frame into it at the third floor, the plates were made long enough to act as hangers to carry these girders, since a column splice coming between did not have the necessary strength to permit using the column as a hanger. Col. 52-A stops at the third floor under a skylight and carries two girders. In this case the plates were made long enough to pick up the column from the fourth floor, the column section itself being used as a hanger to carry part of the load.

two wedges were inserted, which were tightened by screw jacks as the column was lifted. These wedges tapered 1:16, and their motion gave an accurate measurement of the amount of lifting done. The readings of the jack pressure gages gave an accurate measurement of the total load on the columns.

The anchor arm columns (93, 94 and 95) were detailed with a special splice at the first-floor level to allow the back arm to hang free. The splice plates were attached to the lower sections; the upper sections were left plain for the length of the splice plates. An opening of about 1½ in. was left between the upper and lower sections to allow play. To secure this opening, the columns were erected on temporary wedges, and when the trusses were completely erected and riveted these wedges were drawn, leaving the back arm hanging free. The load of the old building columns would then be relieved gradually as erection progressed.

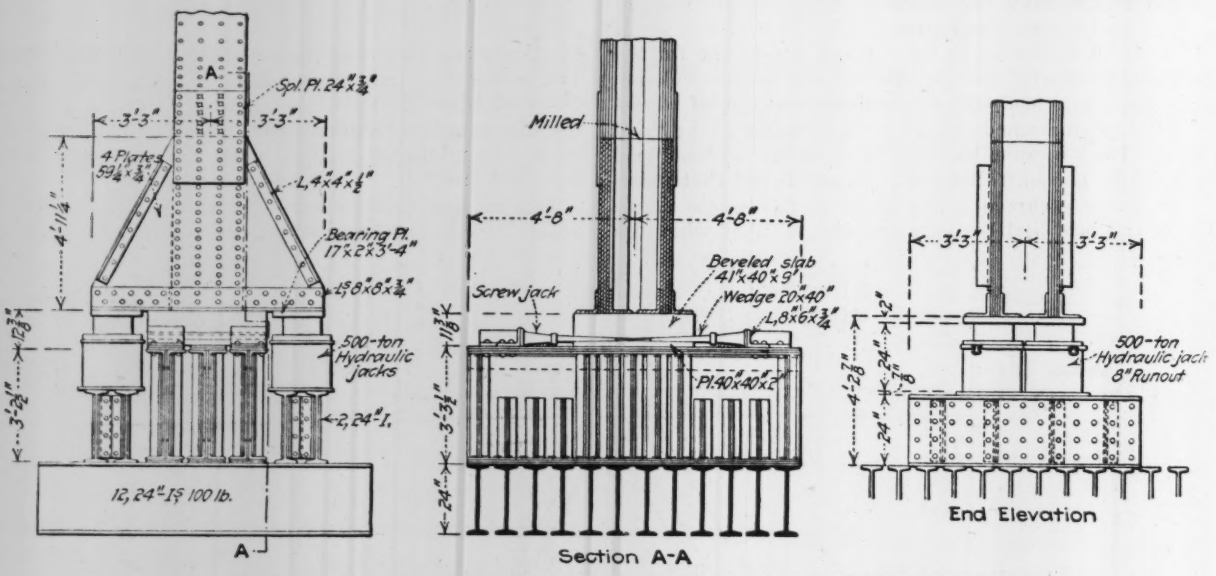


FIG 4. PROVISION FOR JACKING FULCRUM COLUMNS TO TAKE UP COMPRESSION

Taking Up the Elastic Distortion—The fulcrum point of each truss had to be kept at constant elevation throughout the operation. As the load on the trusses increased, the fulcrum columns (Cols. 101, 102 and 103) would compress; and, correspondingly, the old building columns would lengthen as they were relieved of their load. This would tip the system. To offset such effect, the fulcrum column was raised when found necessary to maintain its level. This raising was done by the use of four hydraulic jacks under each column at the grillage.

Four 500-ton jacks were therefore placed under Cols. 101 and 102 and four 200-ton jacks under Col. 52-A. They rested on the lower layer of grillage and received the load of the column through wing plates. The heavy slabs of the permanent column bases were beveled and

As soon as the trusses were erected, the first-floor splices of the old columns were cut, leaving these columns free to be lifted off their bases at that level without lifting the basement load. The relieving of these columns was observed by extensometer readings, in connection wtih extensometer readings on the truss members. When these readings showed that all load was out of the first-story sections of the old columns, the gap in each anchor column at the first-floor splice was closed with fillers, the column was drilled to fit the holes in the upper half of the splice plates, and these splices were riveted. The old columns were not burned off immediately, but were left in place till sufficient load was erected on the back arm to give a big factor of safety.

In erection the cantilever gusset plates were attached to the old building columns before any other steel was erected. As the truss connection of these plates had been left plain for fitting in the field, the end posts were first fitted to the fulcrum gussets and the cantilever gussets then drilled to match the posts The connection was then riveted, whereupon the rest of the truss members could be erected in order.

Operation Checked by Strain-Gage Readings—Ex-

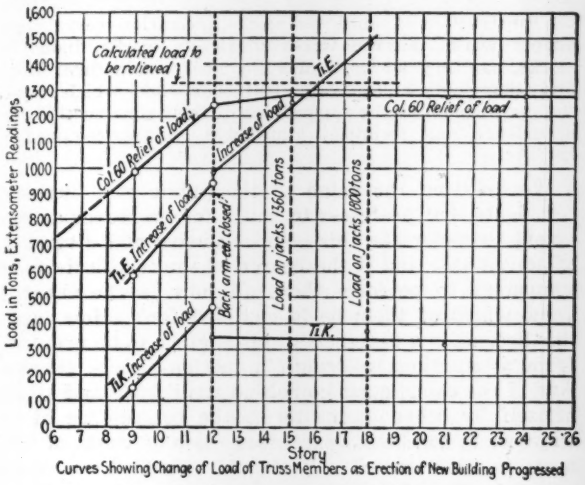

Load in Tons, Extensometer Readings
Story
Calculated load to be relieved
T.E.
Col. 60 Relief of load
Col. 60 Relief of load
Increase of load
T.E. Increase of load
Back arm set closed
Load on jacks 1360 tons
Load on jacks 1800 tons
T.K.
T.K. Increase of load
Curves Showing Change of Load of Truss Members as Erection of New Building Progressed

FIG. 5. LOAD TRANSFER MEASURED BY STRAIN-GAGE

tensometer readings were taken on all members and supporting columns before any load was on, before the back-arm wedges were drawn, after these wedges were drawn, and thereafter as increments of load were added, using the material shipments of three stories each as a basis of the weight calculations. The extensometer used was a 20-in. Berry strain-gage reading to 0.0001 in. The points were marked by ⅛-in. round holes drilled to such depth that the point of the instrument would not reach the bottom of the hole. Four readings were taken on each member to give a good average.

In taking such extensometer readings various difficulties are likely to result from the natural conditions of the work. As instanced in this case the temperature cannot be measured with any accuracy, since the different members or even different portions of the same member vary in temperature due to pouring of concrete, streams of water flowing near a member, partial exposure to the sun or other causes. To illustrate the range of temperature conditions: the initial readings were taken at the end of July, at a temperature of 92 deg. F.; by the time of the next measurement a tier of steel had been added and floor arches were in process of pouring, so that the columns were in the shade; the last set was taken in December, after the building had been enclosed, at a temperature of 52 deg. F. Difficulty was met in the unusual amount of dirt that would clog up the gage-point holes, the holes were cleaned with waste and oil before each reading, but this did not eliminate the inaccuracy entirely. Nevertheless the extensometer readings were fairly accurate and served excellently to check the calculated stresses.

Levels were maintained daily on the fulcrum point of each truss, and the fulcrum columns were jacked into position from time to time.

The wedges in the anchor columns were drawn when the trusses were completely riveted and inspected. By this time the sixth-floor steel had been erected and much steel was lying on the deck, so that the back arms were cut loose under a load corresponding to steel up to the ninth floor. The fulcrum column was held on the jacks at the proper level, while the wedges were withdrawn gradually from the four sides in rotation to avoid a shock. The levels showed a drop of ⅛ in. at the truss fulcrum point, which was immediately taken up on the jacks. The splices were filled and riveted at the time when the old columns were completely relieved, as indicated by computation, checked by the extensometer. This time was, in the case of Trusses 1 and 2, when erection had proceeded to the twelfth floor and floor-arch construction to the eighth, and in the case of Truss 3 when steel was erected to the twelfth floor with arches to the fifth.

The jacks under the fulcrum columns had to be removed earlier than was desirable, because of the cofferdam bracing which framed into these columns. A concrete engine bed, which carried up to Basement "C" was to be placed near these columns, and the floor beams for the basements below had to be framed between the columns and this bed. As the jacks occupied part of the space where this engine bed was to be put, the pouring of this mass was omitted and the basement beams framing into it were left out till it became necessary to put them in. This was done at the last

FIG. 6. OLD COLUMNS READY FOR LIFTING TRUSSES

possible minute short of delaying the job. The cofferdam was held on temporary wooden shores during this time. It therefore became necessary to take the jacks out before the transfer was finally completed.

Column 52-A was cut when erection had proceeded to the 26th floor, with floor arches built to the 20th floor. A new set of extensometer readings was taken on the section before and after burning. Level readings on the cantilever end showed no deflection, but the extensometer showed a remaining load of about 50 tons in the column. Column 60 was cut when the steel was entirely erected, all floor arches in and the old building wall partially removed. The burning was a much longer job in the case of this column and in that of Column 56, as it was necessary to burn out a 6-in. length to get at the center web. The level showed a drop of slightly less than ⅛ in. Column 56 was cut two days after Column 60 and showed the same results.

The work was most successfully accomplished. The following were instrumental in carrying it through: Welles Bosworth, architect; S. C. Weiskopf, consulting engineer; Marc Eidlitz & Sons, Inc., builders; Post & McCord, Inc., steel contractors and erectors.

A Rational Approach to the Licensing Problem

An Effort to Suggest a Viewpoint and to Formulate the Principles that Should Govern Consideration of the Problem

An Editorial Discussion

EVERYONE has heard the adage about not being able to see the forest because of the trees. It is a situation of this sort that has complicated the thinking of many engineers on the licensing question. They have found themselves almost overnight in the midst of the problem, touched closely here and there by special phases of it, but so far as they have been able to see, wholly unaffected by others. It has been difficult for them to grasp the entire scope of the subject, to explore its recesses, to skirt its boundaries.

What follows is designed to offer a viewpoint and to indicate an approach for those who would broaden their thinking on the question. It is not intended to be a definitive and exhaustive discussion leading to an inevitable and rigid conclusion. It is intended to present an airplane view of the forest rather than to plot its contour by metes and bounds. It aims only to focus attention and to provoke thought.

To begin with, we would submit the principle that the question of licensing engineers under the law is essentially a public and not a professional question. It concerns an exercise of the police power of the state to protect its citizens against exploitation or injury that they individually would find it difficult or impossible to avert. Laws are not properly made to subserve the interests of any profession or vocation. The enactment of such laws would constitute class legislation, and as such violate the spirit of our institutions. The benefits that might be derived by engineers from the operation of a licensing law is, therefore, not a legitimate argument for its enactment and will avail nothing with conscientious lawmaking authority. There is, then, but one question to be answered. *Does the public interest require that the right to follow the vocation known as engineering be restricted and regulated by the state?* Unless we can answer yes to this question there is no case for licensing, whatever might be its influence on the interests of the profession and those that compose it.

To answer this question we must begin by asking other questions. What, for example, do we mean by the "vocation of engineering"? How does it touch the public interest? By what form of regulation can that interest be most effectively safeguarded?

* * *

In some of the licensing laws that have been enacted an effort has been made to describe the activities of the "professional engineer." The result of that effort is the following, extracted from one such law:

"Professional engineering" means the practice of any branch of the profession of engineering other than military engineering. The practice of said profession embraces the design and the supervision of the construction of public and private utilities, such as railroads, bridges, canals, harbors, river improvements, lighthouses, wet docks, dry docks, ships, barges, dredges, cranes, floating docks and other floating property, the design and the supervision of the construction of steam engines, turbines, internal combustion engines and other mechanical structures, electrical machinery and apparatus, and of works for the development, transmission or application of power, and the design and the supervision of the construction of municipal works, irrigation works, water supply works, sewage works, drainage works, industrial works, sanitary works, hydraulic works, structural works and other public and private utilities or works which require for their design or the supervision of their construction such experience and technical knowledge as are required by this Act.

We question the value to the public of a licensing certificate that professes to vouch for its bearer as competent to undertake this comprehensive and diverse lot of activities. And if the bearer of the certificate is not competent to perform them all how is the client to know which of them he is qualified for? How, under this license, is a designer of gas engines to be prevented from attempting to design a motion-picture theater? And if the client must go behind the license and satisfy himself by other means as to the competence of the engineer to handle his particular piece of work, of what avail is the license? We would submit as a second principle, that if the state undertake to vouch by license for the technical qualifications of an engineer it should define accurately the type of engineering work it has found him competent to undertake.

* * *

Having examined the fields of work ranged by the "professional engineer," we may next try to define the activities of the individual engineer in those fields. Unfortunately, the word "engineer," even when limited to a particular field, does not convey a clear-cut and definite image. We need not be detained here by its traditional use to describe the locomotive engineman and the operator of other machinery, but will consider only those who may be included under the term "professional engineer." Who are they? How may we define them? The word "engineer" has come to define a general type of education and training rather than a vocation. Those who have received such an education and training may be found employed in any one of three classes of engineering work.

The first, by far the greatest of the three, includes those that have no ultimate technical responsibility. Their titles may range from "tracer" or "rodman" to "deputy chief engineer." Their distinctive characteristic is that their judgment and their work are subject to technical review and technical direction by superior technical officers who assume full technical responsibility for them.

The second is made up of those upon whom rests ultimate technical responsibility. These men report in general to laymen or to lay boards or commissions, who are unqualified to pass judgment on technical matters and who, in consequence, are wholly dependent on the technical skill and judgment of their advisors. This class divides into two groups. In the first is found the engineer that is employed, usually for his full time, at a salary. He is part of an organization and often performs, in addition to his technical services, certain administrative duties. His title usually is "chief engineer." The second group of the class includes the "consulting engineers" as that term is broadly used to describe the independently practicing engineer who will undertake for a client, on a fee basis, investigations, designs, or the supervision of works. In general such men are essentially specialists, without executive responsibilities, but having ultimate technical responsibility.

The third class includes those that apply their engi-

neering training and talents to a business, industrial or mercantile, in which they are predominantly interested in the commercial aspect. They may be contractors, manufacturers, or salesmen. In general, this class is not included under the operation of licensing laws.

We cannot see that the state licensing of all the engineers employed on a certain piece of work or in a certain industry would be either necessary or desirable. As in every enterprise there is some individual who bears ultimate technical responsibility, why should the state extend its voucher beyond this person? If it does, where should it draw the line? We are inclined to formulate as a third principle that any licensing requirement should apply to those engineers only who are called upon to bear ultimate technical responsibility. It is possible that this is the intent of some of the laws already enacted but much uncertainty prevails concerning it.

* * *

Obviously, the work of some of these men touches the public welfare and security, and its conduct is legitimately a matter of public concern. But in seeking to conserve the public interest in this respect, we must avoid being misled by the analogy so often drawn between the engineer, on the one hand, and the doctor and lawyer on the other, both of whom practice subject to license but for reasons that have scarcely any bearing on the case of the engineer. Reasoning by analogy is quite legitimate provided the analogy is sound. But the assumption that because doctors, lawers and engineers are all "professional" men, that which may be desirable or necessary in the case of the first two is also desirable or necessary in the case of the last, is not "reasoning" at all. It is simply an illogical and slovenly mental process that seeks, for one cause or another, to avoid reasoning. And this process has been responsible for much of the loose so-called "thinking" on the licensing question.

The doctor and the lawyer, in the main, both deal with the individual. Every man, woman, and child is a prospective client of the doctor and the lawyer. However poor, illiterate, or ignorant, any citizen may at any time require the services of a doctor or a lawyer. When he enters the office of the man who displays his shingle as a doctor or lawyer the plain citizen has the right to feel that this man has been vouched for by the state. There is no other way to protect him. The state cannot examine and approve the prescriptions of the doctor; it cannot scrutinize the briefs of the attorney, for these may involve intimate personal matters in which, indeed, the state may be at odds with the individual. The citizen, in general, has neither the time, the ability, nor the resources to investigate the qualifications or standing of this individual into whose hands he is about to entrust his liberty, perhaps, or his very life. So in lieu of a more effective method, public policy demands that the doctor and the lawyer receive the seal of the state before they offer their services to the general public.

But do these considerations apply in the retaining or hiring of an engineer? We think not. From the very nature of the case, those who seek the services of an engineer possess capital or command capital. They are, in general, responsible and of substance. They may be assumed to have the intelligence, the resources, and the time to determine the fitness of an engineer to counsel them wisely and to handle their property with technical discretion. The standards of their investigation will probably be higher, and will certainly be more specialized than any that might be prescribed by the state in any reasonable licensing law. We would submit, then, as a fourth principle, that there is little if any ground for licensing engineers in order to protect their employers against charlatans.

* * *

Yet, as has been pointed out, certain works usually carried out under the direction of, or according to the plans of engineers may have a bearing on the public security quite aside from the interests of those who own them. Buildings and public works of many sorts will come under this head; it is unnecessary to go into detail. Carelessness or incompetence here may have a far-reaching public effect. That this is recognized is indicated by the enactment of building laws and other protective measures designed to provide technical supervision by the state over certain structures and appliances, failure of which would create public peril.

But before leaping to the conclusion that this situation demands the state licensing of engineers we must answer these questions: Are present laws for the protection of the public against such failures inadequate? Has state supervision over plans and operations been carried to its maximum usefulness? Does the public safety demand that the state go back of the work itself and certify to the competence of all those who may be called on to plan and execute such works? Will the net results of such a procedure measured in increased public safety justify the labor and expense involved in its administration? From all of this we would formulate a fifth principle: If the state is to license engineers it should confine such licensing to fields which have been shown by experience to harbor possibilities of public peril, and which cannot be more effectively supervised by other methods. In this connection we should remember also that many failures of engineering structures have resulted not from faulty design but from faulty execution, so we would submit as a sixth principle that if the state is to license engineers at all it should provide for supervision of work by licensed engineers from plan to completion. Experience has demonstrated the futility of adequate designs in the face of incompetent inspection.

* * *

To summarize the principles that have been here laid down we submit the following:

1. Licensing must be justified wholly on the ground of the public welfare and not at all on that of professional advantage.
2. To be of value to the public a license must define accurately the kind of engineering work in which the licensee is qualified.
3. The requirement of license need apply only to those having ultimate technical responsibility.
4. Licensing is not required to protect those who need the services of an engineer against imposition by charlatans.
5. Public protection by licensing should be considered only for those fields in which experience has demonstrated the possibilities of a public peril that cannot be more effectively provided against by other methods.

6. Public protection by license should cover every phase of the fields so protected in order to insure unbroken technical responsibility from inception of plan to completion.

We believe that if the licensing of engineers is to be justified it must be established on the basis of these principles. Some of them have been observed in some of the laws that have already been enacted. We are persuaded that the closer the licensing movement clings to the requirements of public policy and the more nearly it conforms to all these principles, the more likely it is to accomplish the public service that is the avowed purpose of its advocates.

Defends Licensing of Engineers

Urges Need of Laws for Protection of Qualified Engineers and the Public, and to Make Engineering a Real Profession

By Harry Tucker
Professor of Highway Engineering,
North Carolina State College of Agriculture and Engineering

During the past few months *Engineering News-Record* has contained letters and editorials on the licensing of engineers, some of which have not been favorable. It is believed that most of these criticisms arise from a lack of appreciation of the need for registration laws. For two years the writer was secretary of a state society of engineers and had an unusual opportunity to become thoroughly familiar with conditions in the engineering profession in this section of the country. Based on these, the most important needs for registration of engineers are: First, for the protection of the qualified engineer; second, for the protection of the name "engineer"; third, that the standards of the profession may be raised; fourth, for the protection of the public.

It is not possible here to discuss fully each of these reasons. Suffice to say that, before the enactment of registration laws in certain states, many persons practiced engineering and styled themselves "engineers" who, apparently, had no qualifications for the profession. To cite instances; plumbers and steam fitters advertised their firms as "expert heating engineers," wiremen called themselves "electrical engineers," many land surveyors styled themselves "civil engineers," and nationally known manufacturers advertised their agents as "heating and sanitary engineers." These are not isolated cases; they were all too common in this section. There would, perhaps, be no serious objection to these men using the word "engineer," except that they were qualified neither by experience nor education for the profession. They simply thrust themselves bodily into the profession, and made a bid for strictly professional engineering work, often in competition with highly qualified real engineers. In view of this is it any wonder that there has been confusion in the public mind as to just what is an engineer? It would seem that in fairness to the qualified engineer, a suitable standard should be set up for his profession.

The ease with which any one can enter the engineering profession will not be discussed at length here. A letter from "A Civil Engineer's Wife" in *Engineering News-Record*, May 25, 1922, p. 883, gives a typical instance. Many similar instances in this section might be cited. Is education and extended experience necessary to make a good engineer? Undoubtedly yes. But many men have left the grammar school, worked as rodmen for a year or two and then entered upon the *practice* of engineering as an "engineer." It is granted that a technical education is not always necessary to success in the field of engineering. But certainly, without at least a good high school education, a broad experience, coupled with natural ability, is necessary for engineering success. Those who, without natural ability, education or broad experience, enter the engineering profession, lower its standard in the estimation of the public by just that amount. Is it not just to require a man to be duly qualified before entering a profession so important as that of engineering? We boast of the importance of our profession, of the highly technical requirements of a successful engineer; we have great schools for the education of engineers, to fit them for the profession; but in the eyes of the public the profession is one that can be entered by any one upon payment of the general professional license tax in some states, and by merely styling oneself an "engineer" in others.

That the public needs the better protection afforded by licensing is all too evident. Any well-informed engineer can recall many cases of public money wasted by inefficient engineers; many failures of engineering structures due to faulty design; and of the loss of life through such failures. It is not claimed that perfection in engineering works will be attained through licensing. Unfortunately, mistakes will always be made; and more so in engineering where we are building with the successes and failures of our predecessors so much in mind. But engineering works designed and directed by competent engineers are surely more likely to be successful than those built by incompetent engineers. And remember that the main reason for licensing engineers is to set a standard which the would-be engineer must attain before entering the profession.

Every one who has the interest of the profession at heart must admit that there are certain practices carried on by some engineers that are not strictly ethical. Most of these unethical practices may be attributed to the pseudo-engineers. There is the salesman who acts as engineer; the man who is both engineer and contractor on the same job; the material supply man; the manufacturing company that sells engineering products and at the same time undertakes the engineering. Certainly not all such engineers are guilty of unprofessional practice; but in these situations it is easy to infringe the provisions of any satisfactory code of ethics. How can these practices be corrected? The most feasible suggestion is that the engineers formulate a code of ethics, even as the professions of law and medicine. However desirable this may be, a code of ethics will hardly be of much service unless its provisions can be enforced. How can this be done? Through engineering societies? How many of the men guilty of violating such a code of ethics would belong to the societies? Without a means of enforcing its provisions a code of ethics is worthless to correct unprofessional practice. One great advantage to be derived from licensing laws is the means for determining who are engineers, and of setting up standards and rules of conduct. With the enactment of such laws, engineers will be in a position to enforce the provisions of a suitable code of ethics.

That license laws will accomplish any good either

for the engineers or for the public has been questioned by eminent members of the profession. The actions of the Boston and Baltimore engineers indicate the feelings of certain groups. It has even been claimed that the licensing of doctors and lawyers has resulted in no advantage to the professions and the public. This contention has been admirably answered by F. F. Carmiencke, engineer for the Willys-Overland Company, in a letter published in *Engineering News-Record*, March 30, 1922, p. 540.

In this section criticisms of license laws have come from three sources. First, from eminent engineers who have risen high in their profession. These engineers cannot see any need for registration laws. Certainly, they believe that such laws will be of no advantage to themselves. It is believed that this criticism is based largely on selfish considerations. These engineers usually belong to technical societies and see in such societies the means of furthering the good of the profession without license laws. They overlook the fact that there are thousands of engineers just beginning the struggle for existence in the profession and that these young engineers are the ones who later on will answer for the mistakes of the profession. These engineers have also criticized the manner in which the various laws are applied. Those who criticize the application of the laws must remember the difficulties with which the various state boards are confronted. Many of the laws are not perfect, and tedious questions of qualifications and classifications must be considered. It is not possible always to carry out the provisions of any law to the satisfaction of all concerned. Time is needed to perfect their workings. It might be noted that the various engineering examining boards are striving to perfect their organizations so that the full benefits of the license laws may be obtained. It must also be remembered that the benefits of such laws will not always appear immediately. The laws furnish merely the machinery by which the standards of the profession can be raised. The process is strictly one of evolution.

Secondly, criticisms of license laws have come from pseudo-engineers, and those who are not competent to qualify for the practice of engineering under the existing laws. These criticisms, to a certain extent, point the need for such laws. Fortunately, critics of this class are few. Most of those to whom registration has been denied because of lack of engineering education or experience, have accepted the decision of the examining board without question; and many of them have taken steps to gain the education and experience necessary to meet the requirements. This is a further indication that the licensing of engineers will tend to raise the standards of the profession.

A third class of critics consists of certain public officials and citizens; the officials fearful of the growth of the movement for the licensing of all professions; the citizens afraid that, under licensing laws, an engineers' "trust" will be created and that the public will be held up for increased engineering fees. Every effort should be made by engineers to discountenance even a suspicion that their desire to better the profession through license laws is really an aim to create a "trust." It is believed that this criticism is wholly unfounded.

It is unfortunate that there should be any division of opinion among engineers concerning this movement. That there is considerable division is all too evident. The writer believes absolutely that such laws are needed. The question should be thoroughly discussed among the engineers themselves and a unanimity of action be obtained. It must not be forgotten that the proponents of these laws see in them a means for making the profession a real *profession;* and this can only be done by setting up standards which all must pass in order to enter the profession. Except in those states that now have registration laws, there are no standards. It is believed that the registration laws provide the machinery for fixing such standards.

Concrete on Seattle Stadium Fill Did Not Crack

WHEN THE University of Washington stadium was completed near Seattle, Wash., eighteen months ago, an article was prepared for *Engineering News-Record* (Feb. 24, 1921, p. 326) explaining how an earth fill 36 ft. high in places had been built and a concrete surfacing placed upon it immediately without allowing any time for the fill to settle. An editorial accompanying the article suggested that after a year had elapsed there would be better opportunity to judge whether the builders were justified in their claims of the stability of a fill made in this way.

In order to report the present condition of the concrete placed on the fill, R. H. Thomson, for many years city engineer of Seattle and now well known as a consulting engineer of that city, was asked to inspect the stadium and report his observation to editors of *Engineering News-Record.* Colonel Thomson wrote under date of June 9 that he had just made a careful examination of the structure throughout without finding any defects. He says:

"I followed this work during construction with more than ordinary interest because of the novel methods used. W. C. Morse, one of the engineers in charge made the assumption which was accepted by the contractors, that he could forecast the length of time which must elapse before the final settlement of the fill. The curve of actual settlement was carefully checked with Morse's curve of anticipated settlement with the result that the final time required corresponded to within 36 hours and the depth to perfection.

"In order to allow for any settlement which might occur, every third riser was divided so that if settlements did occur the upper part of the riser might tilt back on the lower part and the settlement would be taken care of by the opening of the expansion joints on the face of the riser. This expansion was also placed with the thought of caring for any thermal stresses. In construction the edges of these expansion joints were not tooled and in many places the final brushing of the surface of the concrete put a skin coat over them. In some parts this skin coat has been split by an irregular hair line which to one not acquainted with the form of construction might appear to indicate a defect in or a settlement of the structure but careful instrumental levels fail to reveal any settlement more than 1/100 of 1 in. Critical examination made after the expiration of eighteen months has failed to reveal any defect of construction due to settlement and justifies the prosecution of the work by the methods adopted."

Santa Fe Ry. Has Large Steel-Frame Shop with Glass Walls

Glazing Outside Structural Framing—T-Columns Carry 250-Ton Crane—Folding Track Doors—Repair Pits and Floor Track Construction

EXCEPTIONALLY effective daylight lighting throughout a large new locomotive repair shop, 239 x 604 ft., on the Atchison, Topeka & Santa Fe Ry., has been obtained by the use of glass side walls, supplemented by skylights and by large window areas in the concrete end walls. As the steel sash is placed outside of the wall columns it forms an unbroken glazed surface extending from sill line to roof and for the entire 604-ft. length. This building, of steel frame construction, is the most important feature in the enlargement

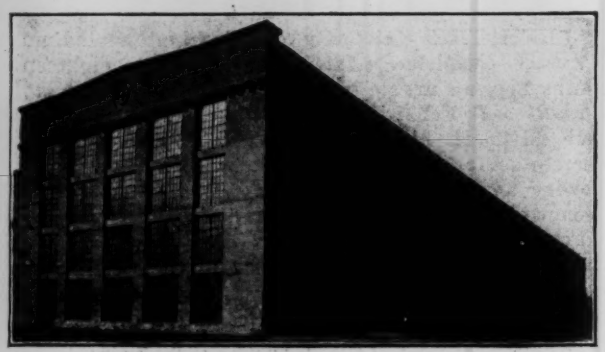


FIG. 1. MACHINE SHOP WITH GLASS WALL 60 × 600 FT.

of the railway company's locomotive and car repair facilities at Albuquerque, N. M. The general views Figs. 1 and 2 show the exterior of the building and the well-lighted appearance of the interior.

Improvements at this point were undertaken early in 1921, having been delayed during the war and the period of government control of the railways. The steel-frame repair shop or machine shop is the most important feature of the work, but with it will rank a large boiler shop 135 x 415 ft., which is to be built later to replace the old machine shop, these two large shops being served by the transfer table in the space between them. In addition to the new machine shop there have been built seven smaller structures, all of which are of reinforced-concrete construction with steel sash and steel doors. These include a flue shop, 46 x 196 ft., power house extension, 78 x 126 ft., waste cleaning shop, cab painting shop, pattern shop, babbitt shop and fire department headquarters. The views of the flue shop, Fig. 3, show the typical design.

Repair Shop Layout—As shown by the general plan, Fig. 4, and shop plan, Fig. 5, an electric transfer table serves the new machine shop, which has 29 transverse tracks, with engine pits in 26 tracks. Two push-car tracks at the east end, for handling material, are connected with a yard track. At the west end is a third push-car track. All are stub tracks, except that the east end push-car tracks are connected to a yard track and the middle engine track is extended through the building and into the adjacent roundhouse. Two of the stub tracks also extend beyond the building to the tire shop and babbitt shop. Engine repair pits, spaced 22 ft. c. to c., are 63 ft. long, with the end 7 ft. from the side wall fronting on the transfer table.

Reinforced-concrete footings constitute the foundations, as shown in Fig. 6, piles being used under columns carrying heavy loads. The soil is sand, with muck below. In the bottom of each footing are four layers of bars for lateral and diagonal reinforcement. Anchor bolts attached to anchor plates and set in 4-in. pipe sleeves are embedded in the concrete, the sleeves giving space to permit adjustment of the bolts to fit the holes in the column base plate. As the concrete was placed the pipe sleeves were jarred and moved up and down to prevent adhesion and when the concrete had set the sleeves were removed. After the column had been secured in place the bolts were grouted into the 4-in. holes. Rough concrete is covered with a 1-in. layer of cement grout which is finished off at grade line and upon which the column base plate is laid.

Structural Design—In its width the shop is divided into four bays, as shown in Fig. 6. Adjacent to the transfer table is the 90-ft. erecting bay, 57 ft. high, in which the repair pits are located. Beyond this are the 65-ft. heavy machine bay, the 40-ft. light machine bay and the 40-ft. bench bay, all of which except the

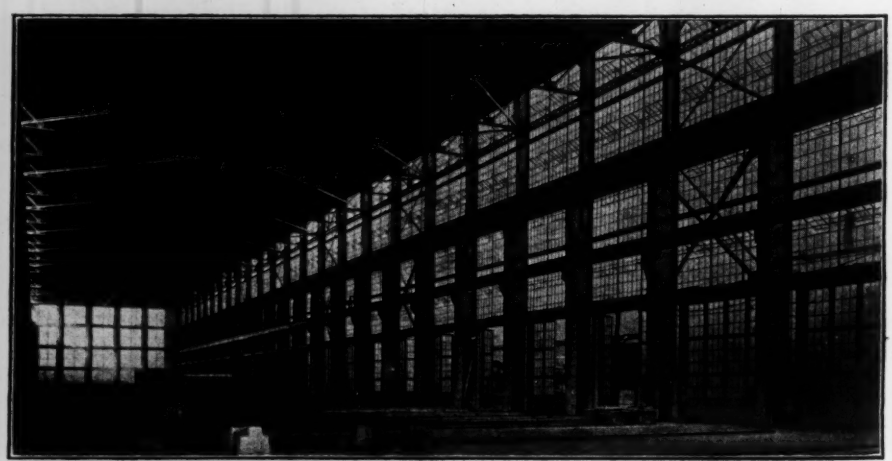


FIG. 2. LIGHT INTERIOR OF SHOP WITH GLASS WALL

last are 35 ft. high. A balcony or upper floor extends the full length of the bench bay, and a mezzanine floor 88 ft. long is arranged between the main floor and balcony. Two electric traveling cranes serve the erecting bay, a 250-ton crane above and a 15-ton crane below. The heavy machinery bay has a 15-ton traveling crane, and the wall columns of the bench bay carry

the runway girder for a 15-ton yard crane. In the light machine bay is a 5-ton monorail trolley carrier.

Wide columns of T-section are employed in the erecting bay in order to carry the crane girders and to give the necessary stiffness for a structure of this height, braced transversely only by the roof trusses. In the lower portion each column is formed by two plates at right angles to each other with connection angles at their junction and flange angles on the edges, as shown in Fig. 6. In the upper portion the width is reduced by using a 24-in. plate for the stem, the offset forming a seat for the upper runway girders. The I-beam runways for the lower crane are carried by brackets. Other columns are mainly of H-section, composed of a 16-in. web plate, four angles and two 15-in. channels with flanges inward, as shown.

Longitudinal trusses, laid flat and framed between the columns, are placed just above the doorways and at the level of the bottom chords of the roof trusses. Vertical diagonal bracing between the columns is provided at intervals of from three to five panels.

Steel roof trusses framed between the columns carry I-beam purlins. Plank sheathing covered with composition roofing is the only wood work in the construction of the building. Over the three rear or lower bays are transverse steel-frame skylights, one in each 22-ft. panel. These are of A-section, glazed with wire glass and have the upper portions hinged for ventilation. At two points the high roof of the erecting bay is extended over into the next bay, forming rectangular monitors, glazed on three sides, the other side being open to the shop. These spaces form the fan rooms and contain the heating apparatus.

Steel-Sash Walls and Doors—All the steel sash for the side walls is set 4-in. beyond the faces of the outer columns, to which it is attached by means of lugs. The purpose of this unusual arrangement is to simplify the construction as compared with sash framed between the columns, and also to avoid any exposure of the structural steel to the weather. The sash is for panes 14 x 20 in., using factory ribbed glass. The same size and kind of glass is used in the doors, which have bottom panels of steel plate. Fig. 7 shows the sash in place before glazing.

Except for short concrete panels 6-ft. high between the door-ways and the steel plates in the lower parts of the doors, the entire side wall is of steel sash and glass from floor to roof, as shown in Fig. 1. Ventilating sash, operated mechanically, represents about 14 per cent of the wall area above the doors. In most cases the movable frames are pivoted at the middle, but at some points they are hinged at the bottom and arranged to swing inward. These ventilators are operated in groups, as this arrangement minimizes the work of regulation and makes it possible to lock a number of ventilators in the same position with one movement.

Hinged steel folding doors of a novel type are used for the track openings, which are 16 ft. 4 in. wide and 18 ft. high. The opening has two doors, each of which is in two sections which fold together, as shown in Fig. 8. The door rails are of heavy steel tubing, well braced, and having steel plate on the bottom panels and steel sash above. When the doors are fully open they project only about 4 ft. beyond the building. In this position they are latched to bumper posts extending the full length of the doorway and braced to the wall columns. The doors are carried by rollers on overhead runways, so that they are operated easily. Some of these doors are provided with hinged pilot doors 2 ft. 6 in. x 6 ft. 3 in., so that men may pass in and out readily. Steel sash is painted dark green on the outside. All the interior steel work is a light gray, thus adding to the general light appearance of the shop.

Concrete walls for the ends of the building have reinforcement placed to form lintels over the window openings. Dressed and close-fitted wooden forms were

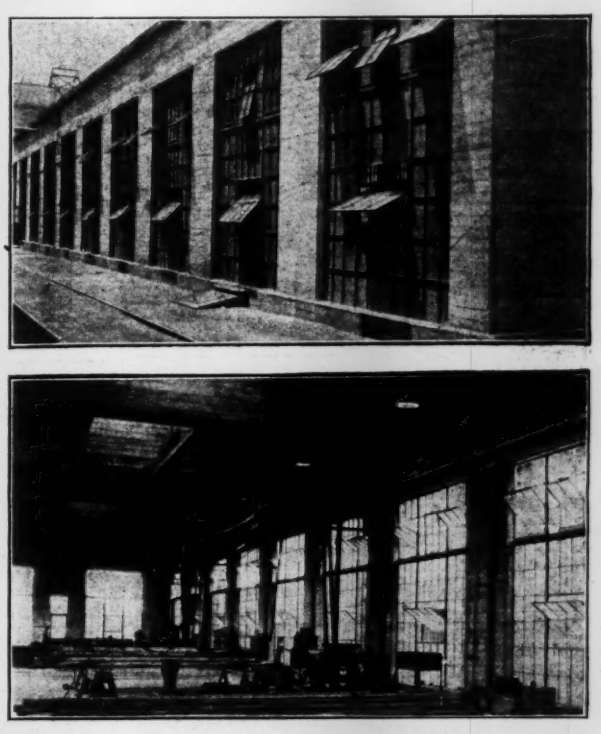


FIG. 3. INTERIOR AND EXTERIOR OF FLUE SHOP

used to give a smooth surface and to avoid form marks. After removal of the forms the concrete surface was rubbed down and given a coat of cement.

Repair Pits—An unusual section is used for the engine-repair pits, Fig. 9, the width being 43 in. in the lower portion and then increased by sloping the sides to a top width of 48 in., in order to give greater convenience for men working in the pits. The depth below rail head is from 2 ft. 8 in. at the inner end to 3 ft. at the outer end, where a sump and drain are provided. At each end and near the middle are side pockets for power wires, air and gas pipes and electric connections. These pockets are covered with removable steel plates secured by bolts. Above each pocket the concrete curb is reinforced by stirrups and bent rods as shown.

The 90-lb. track rails are seated on ½-in. base plates spaced 30 in. c. to c. and are secured by clips and nuts on U-bolts embedded in the pit walls. No jacking planks are used but concrete is filled against the outside of the rail and leveled off at ½ in. below top of rail. Tracks beyond the pits have the rails laid on concrete stringers, with the same arrangement of base plates

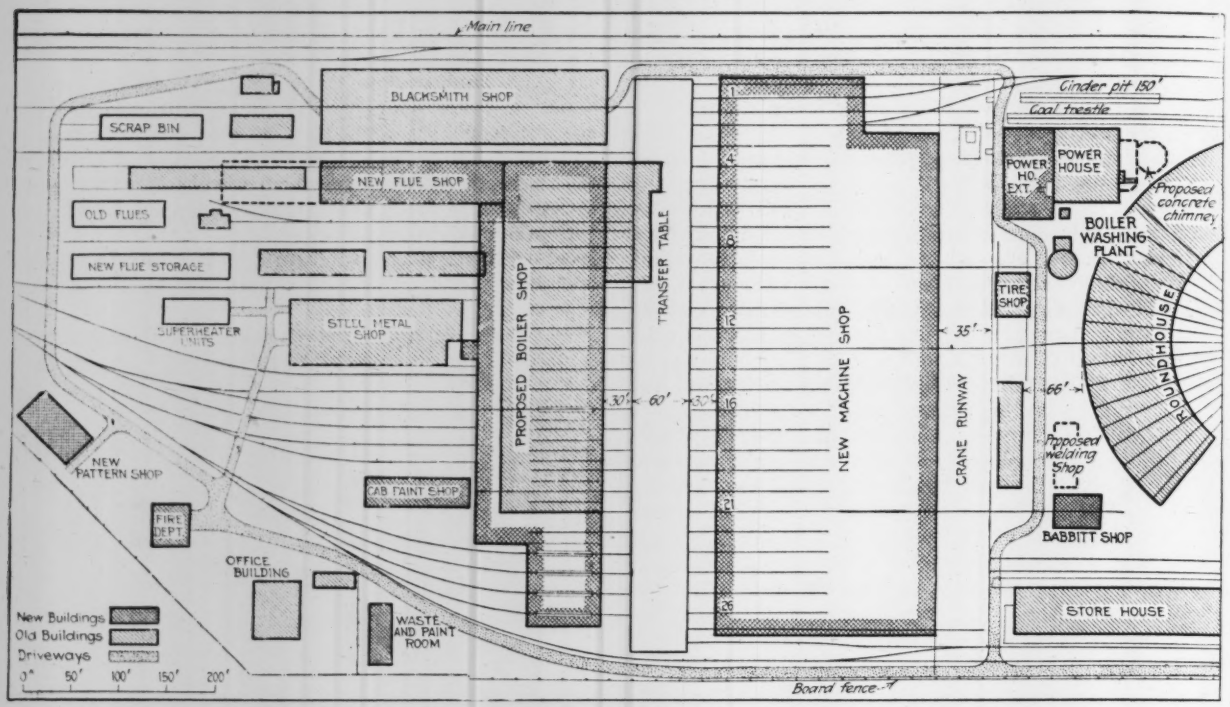


FIG. 4. LAYOUT OF SHOP IMPROVEMENTS AT ALBUQUERQUE, N. M.

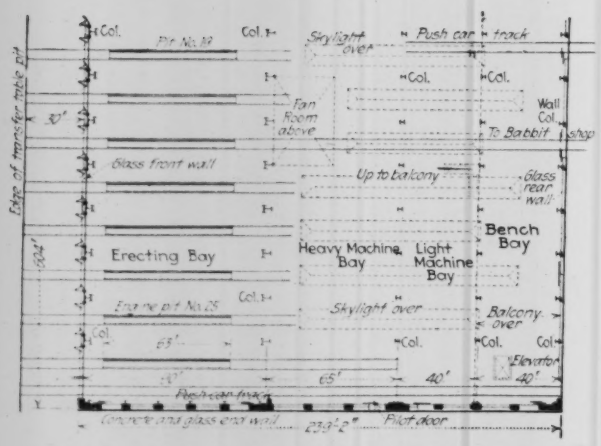


FIG. 5. PLAN OF LOCOMOTIVE REPAIR SHOP

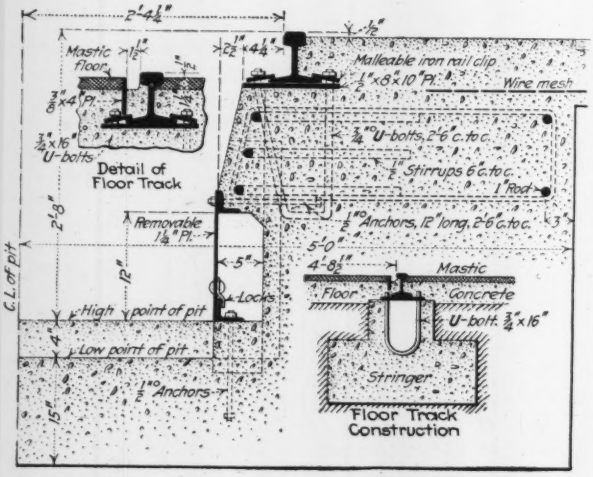


FIG. 7. REPAIR PIT AND FLOOR TRACK

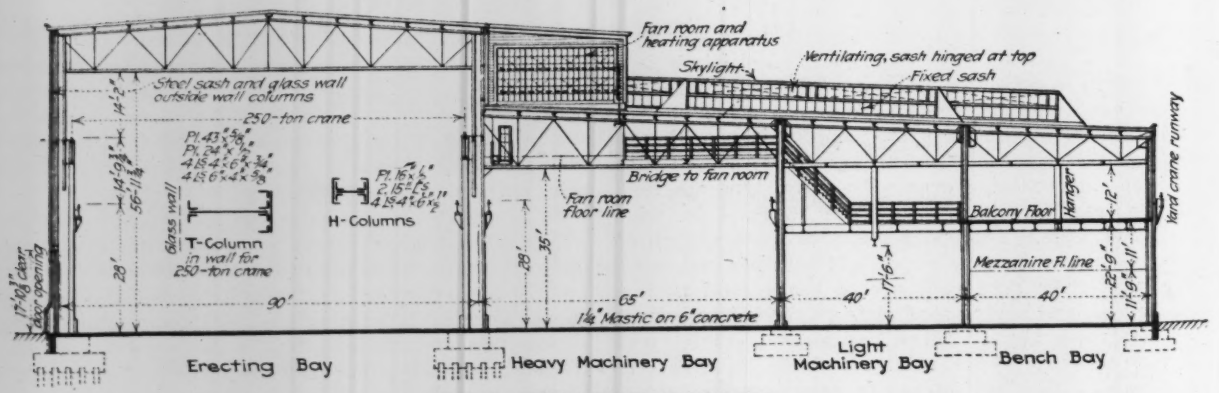


FIG. 6. CROSS-SECTION OF SHOP

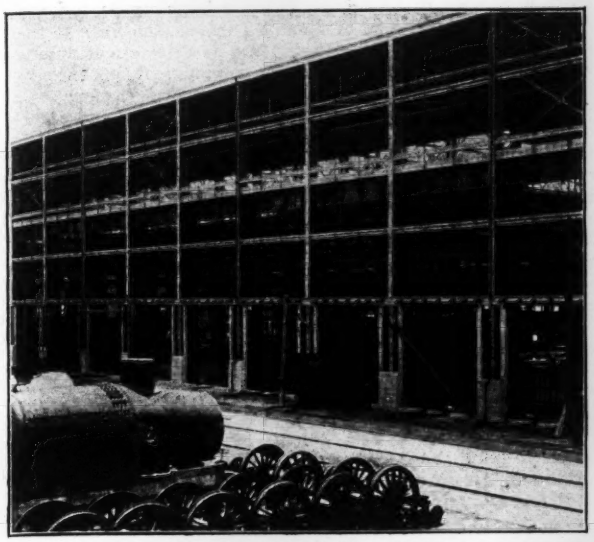


FIG. 8. STEEL SASH OUTSIDE OF STRUCTURAL FRAME

and anchor bolts as described above. Flangeways 1½ in. wide and 1¾ in. deep are formed by flat steel plates set on edge in the concrete, as shown in Fig. 7. The entire floor, except at the pit walls, is covered with 1¼-in. mastic, the surface of which is ½ in. below the top of the rails.

Miscellaneous Features — Hot-air heating is employed, motor-driven fans forcing a current of air over a set of steam coils and then through galvanized ducts. These ducts are laid along the roof trusses and have branches leading down the columns and discharging at a height of 7 ft. above the floor. For electric lighting, the erecting bay has the direct system and the remainder of the shop has incandescent lamps. Sockets for portable lamps are provided in the repair pits.

A framing of 18-in. I-beams and 15-in. channels supports the 4¾-in. slabs of the balcony and mezzanine floors. For these slabs a ½-in. cement finish is used in the wash room and school room, but elsewhere there is a 3-in. treated wood block floor on the concrete slab. On the mezzanine floor are the file room, store room and office toilets, the shop office and general fireman's office being directly below on the main floor.

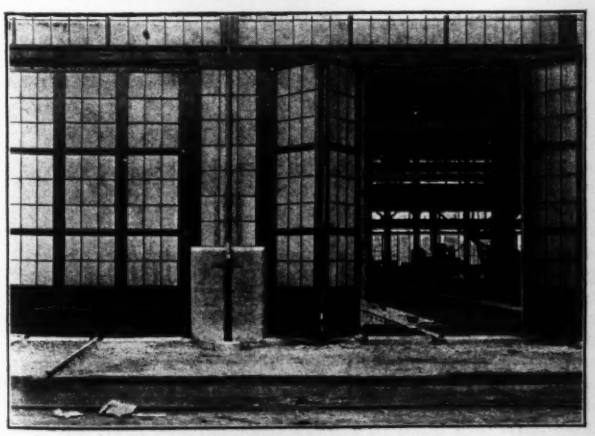


FIG. 9. FOLDING DOORS FOR TRACK ENTRANCES
At left; door closed. At middle; one leaf half open. At right; one leaf full open.

Along the balcony are arranged a tool room, brass shop, electric shop, fan room, school room for apprentices, wash room with 183 faucets over waste sinks and locker room with 864 lockers. There is also a row of 120 lockers in the 6½-ft. corridor which extends the full length of the shop side of the balcony. Partitions and office walls have a steel kick plate 3½ ft. high, surmounted by steel sash and glazing. Stairways and three electric elevators connect the main floor and balcony. The elevator shafts are enclosed with wire mesh, the lower part of which is embedded in a 4-in. wall of concrete to a height of 5 ft. above the floor.

Engineers and Contractors—This large steel shop building and the smaller concrete buildings were all designed by B. P. Phelps, engineer of shop extension, and E. A. Harrison, architect of the Atchison, Topeka & Santa Fe Ry., under the direction of C. F. W. Felt, chief engineer, and John Purcell, superintendent of motive power. The construction was carried out under the supervision of F. M. Bisbee, chief engineer of western lines. Joseph E. Nelson & Sons, Chicago, were contractors for the machine shop, the steel work for which was fabricated by the American Bridge Co. Contracts for the concrete buildings were divided between V. E. Ware, El Paso, Tex., for the power house extension and C. A. Fellows, Los Angeles, Cal., for the miscellaneous buildings. All the steel sash work was furnished by the Truscon Co., Detroit and the special folding doors for the track entrances were made by the Richards-Wilcox Mfg. Co., Aurora, Ill.

These buildings, together with machinery, equipment and the proposed new boiler shop, will represent an expenditure of about $2,500,000.

Engineering Evidence Given in Boundary Dispute

Evidence of engineers was involved in the arguments in the Supreme Court recently in the case involving the boundary between Oklahoma and Texas over the stretch of 600 miles covered by the Red River. The government, appearing as intervener, upheld the contention of Oklahoma that the boundary extends to the extreme flood level of the river to the Texas bluffs, while Texas and various oil interests claiming lands under Texas titles contended that the boundary was at the usual and ordinary level of the river.

The Supreme Court last April fixed the boundary along the south bank of the river and the recent question before the court was what constituted the south bank. Texas contended that if the boundary is fixed as claimed by the government and Oklahoma, that Oklahoma will take from Texas more than half a million of acres of land south of the river with its improvements and a portion containing deposits of oil. It asserted that Oklahoma made no claim to the land south of the low water stage until after oil development began there in 1918.

Surveying and engineering evidence was given by Robert W. Livingston, who, it was said, has been continuously in charge of a surveying party on Red River for two years. The main engineering evidence for the government was given by Major Charles H. Miller, who had 13 years' experience with the Corps of Engineers of the army under the Mississippi River Commission in important work between the mouth of the White River to Vicksburg.

How to Mend the Broken Year in the Coal Industry

Regulation of Output Must Depend on Regulation of Demand—What Consumers Can Do to Deflate the Price of Coal

By George Otis Smith
Director, U. S. Geological Survey

Abstract of address before National Conference of Social Work, Division of Industrial and Economic Problems, Providence, R. I., June 26, 1922.

THE present lack of public anxiety over the coal situation is not at all novel. The average citizen cannot get interested in the coal question in midsummer. Yet disregard of unpleasant facts does not stave off disaster. Nation-wide paralysis of industry and transportation is the natural outcome of a coal shortage if carried to the extreme that cannot be many weeks distant. Serious as the present situation is, however, there are fundamental problems more insistent for solution than even the pending differences between employer and employee. These problems affect the whole coal industry to some degree but especially the bituminous branch. Clear up the economics of the business and a lasting settlement of the labor controversy becomes a possibility; otherwise industrial peace cannot be expected to survive the usual two-year armistice.

What is needed is reform of the business rather than compromise between parties to the controversy. Too long have the mine owners treated the coal business as private privilege and too long have the labor leaders with no less monopolistic attitude obstructed every move for efficiency and economy. The people's coal costs too much because of the mistaken idea that mine owner and mine worker can continue to fight over contracts and rules. Cheaper coal and larger earnings will come when engineering is emphasized more and bargaining less. In terms of engineering, the coal industry has a bad load factor; translated into human relations, poorly functioning mines mean poorly employed miners. A longer working year would seem at first glance, desirable to mine owner, mine worker, and consumer.

Cause of the Trouble—The trouble is not so much the broken year as the broken month, the broken week, and even the broken day. The running time is broken into small pieces, for mine operation is not simply seasonal, it is intermittent. In that theoretical mine of the statistician, the average mine of the country, we find November a longer month than June, by 25 per cent, and June longer than April, by 10 per cent, and yet the working time in a normal November is only 19 to 21 days. And irregularity creeps into the working week and the working day, for Friday and Saturday are normally shorter days than Monday. Granted that the workers in other industries suffer the handicap of seasonal unemployment, our problem, and the national problem just now, is the betterment of the working time of coal mines, and especially bituminous coal mines. The average working time by states and fields shows marked and significant differences. The average year in the southern Appalachian region is a fourth longer than the average year in the Central Competitive district. With 215 days as the average year for the whole country we find a 273 day average year in New Mexico, 247 days in Alabama, and 223 days in West Virginia, as against 202 days in Missouri, 197 days in Illinois, and 192 days in Oklahoma.

Markets, quality of coal, mine costs (including wage scales), and car supply are all factors contributing to these differences in mine employment. Unfortunately, we can gage results better than determine causes; we know the industry to be wasteful, but where are the leaks? The lack of efficiency and the losses due to irregular operation are not universal, for many individual mines work 300 days in the year. Indeed in 1913 when the bituminous mines averaged 232 working days, one-fourth of the half-million men in the industry were employed in mines that worked 280 days or more and nearly 50,000 of them in mines that worked 300 days or more. Our problem, then, is simply to bring the average mine up to the best.

First among methods of mending the broken year is that of stabilizing the coal market. My first practical suggestion for bettering conditions of employment at the coal mine will be addressed to the coal consumer. A more regular market is the first essential, and here is the consumer's opportunity to co-operate. You and I need to buy coal at times when we need it least. Off-season delivery of coal, even to the small consumer, will help materially to make the mine worker's June more like his November. Also, each of us should buy of one dealer, not "shop" for coal. If you or I speculate in our 10-ton purchases of coal, how can we deplore the speculative tendency of our coal dealer and the chain of business hazards thus initiated? Is it not plain that the retail dealer who can depend on his regular trade can himself be a better customer of the wholesaler or the selling agent of the mine? The large consumer can do even more to smooth out the irregularities of mine operation by making long-term contracts, and providing for delivery to suit the mine as well as himself. Such contracts could be made at lowest prices, for with long-term contracts in hand the mine operator could reduce his costs to a minimum. With such a steady market, full year operation and steady employment would become possible—the mine worker would earn a year's wage, and the public would not pay for idleness. That reform, however, must begin at home, not at the distant mine.

The Effect of Regular Demand—With market demands more regular, fewer mines and fewer miners can and should furnish the needed coal. Mr. Peabody as a representative operator admits than one-third of the operating mines represent a burden on the industry, and he suggests their elimination through bankruptcy. Ellis Searles, the editor of the *United Mine Workers' Journal*, admits that 150,000 miners, like one-third of the mines, should be eliminated, and he suggests that they leave the mine for the farm. Mr. Peabody estimates that the idle days of our bituminous mines involve an annual loss to the capital and labor employed of not less than $400,000,000, and I suspect that most of this loss is paid by the consumer.

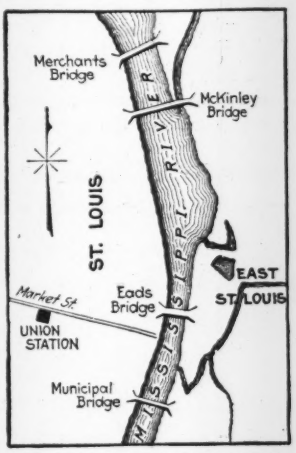
A longer working year for a reduced force is the only possible method of bringing about the lower wage scale and the larger annual earnings, both of which are generally needed. It is largely by reason of the high unit rate of wages that coal costs too much, and on broad economic grounds it may well be questioned whether the producer should be paid a wage out of all proportion with the wage of the consumer. Can a $5-a-day workman afford to buy coal mined by a $10-a-day mine worker?

To hasten this needed deflation, even though it be accomplished through the working of the law of supply and demand, there must be a better informed and more aroused public opinion. Whenever public interest is aroused in the coal question, the defensive note of the coal men is likely to be that appeal for "less government in business," an appeal with which I sympathize so far as governmental regulation might drag politics into business. The political danger that really confronts the coal business is that the leaders in the industry will too long be blind to the trend of the times. Old ways of doing business are not to be the new ways. Our reverence for the privileges and rights of private business is giving way to a new attitude: We are asking what is private business and what is public business. Forced to extremes by private disregard of public interest, this tendency in popular thought may even become dangerous, and Secretary Hoover's recent statement to the operators that "if our coal industry does not govern itself it will surely be governed by the public" was a warning of that danger. So I suggest that if "less government in business" is desired, the best means to that end is *more business in business.* Our best mines are so planned and equipped and operated as to demonstrate how efficient coal mining can be, and a similar statement can doubtless be made of certain units in the merchandising of coal; yet the average coal mine and the average coal yard are far from being gratifying exhibits of that engineering ability or business thrift which we like to regard as typically American.

Recommend Improvements for St. Louis Terminal

Engineers Plan Revision and Unit Operation for Complicated Railway System on Both Sides of Mississippi

UNIT operation of railway terminals and complete rerouting of traffic over the four Mississippi River bridges at St. Louis, Mo., are the high points of a recent comprehensive report by a committee of engineers appointed in 1920 to report to the terminal committee of the St. Louis Chamber of Commerce. This report covers also the terminals of East St. Louis, Ill., which form an integral part of the St. Louis terminal system and industrial district of about 625 square miles. It is pointed out that the improvements are so extensive as to be extended necessarily over a considerable term of years, but it is recommended that a committee representing the railways and the public should be created to provide for the carrying out of these improvements in logical order, with such changes as time may prove desirable.



ST. LOUIS TERMINAL DISTRICT AND ITS BRIDGES

This committee is constituted as follows: F. G. Jonah (chairman, chief engineer of St. Louis-San Francisco Ry.; Harland Bartholomew, engineer of St. Louis plan commission; P. W. Coyle, traffic commissioner, St. Louis Chamber of Commerce; E. A. Hadley, chief engineer, Missouri Pacific Ry.; J. B. Hunley, engineer of bridges and structures, C., C., C. & St. L. Ry.; R. D. Sangster, industrial commissioner, St. Louis Chamber of Commerce; C. E. Smith, consulting engineer for City of St. Louis; F. J. Stimson, chief engineer, maintenance of way, Pennsylvania Lines (Southwest region); D. O. Thomas, consulting engineer for East St. Louis Chamber of Commerce; Charles H. Diehl, secretary. The conclusions and recommendations are summarized below.

Unification — The principle of unification has been retained as far as economically practicable. Passenger traffic is already unified. There should be complete unification of the classification and interchange of cars, which constitutes approximately 85 per cent of the freight traffic. The committee recommends that each railroad should continue to serve the territory local to its own terminals within this district.

Mississippi River Bridges—All passenger trains, except those of the Wabash Ry. which use the Delmar station, should be removed from the Merchants Bridge and from the congested terminals in North St. Louis. The Eads Bridge should be abandoned for railway traffic. The Municipal Bridge should be provided with new approaches and connections to accommodate passenger trains transferred from the Merchants and Eads bridges. The Municipal Bridge should be used also for such freight as can be handled more expeditiously than by other crossings. The McKinley Bridge (electric railway) has capacity for much more freight than it now handles, and should be provided with additional approaches and connections.

The upper decks of the Municipal and Eads bridges should be for highway traffic free of toll, and the highway on the McKinley bridge also should be free. The lower decks of the Eads bridge and its connecting tunnel in St. Louis should be abandoned for steam railway service and utilized for street railway and interurban traffic.

Union Station and Mill Creek Valley — The railroads should acquire additional property in Mill Creek valley south from the Missouri Pacific Ry. to Gratiot St., which will enable the tracks of the Union Station to be lengthened and the approach curves flattened. Engine terminal facilities, coach yards and a yard for making up and breaking up passenger trains should be located west of the station. The station facilities should be improved and the present arched trainshed replaced by a low-roof type of trainshed. In front of the station, Market St. should be widened to form a plaza (as provided by a recent city ordinance) and 20th St. along the side of the station should be shifted south so as to line up with the same street west of Market St., thus eliminating a jog in the street line and giving the Union Station 140 ft. additional frontage on Market St.

Carload Freight—The present system by which each road classifies its own inbound freight for direct delivery to each railroad with which it connects should be abandoned, the interchange of freight between railroads being completely unified. Eight outer group yards should be established at which inbound trains (except local cars) would be stopped and classified and outbound trains made up. Each railroad should continue to serve its own local freighthouses, team tracks and industries. Additional team tracks for joint use of all railways should be provided.

L. C. L. Freight — Freight stations in St. Louis for the east-side railroads are not recommended, but the present system of universal off-track freight stations operated by transfer companies should be extended.

Merchants Bridge Elevated Ry.—This elevated line along the river front should be extended north and south.

East St. Louis—On the east side, passenger trains should follow elevated routes through the congested freight terminals, and a new east-side union station should be built. Freight terminals should also be rearranged to reduce the number of grade crossings.

River Front Development—The river should be straightened north of the Merchants Bridge and the harbor lines south of the Municipal Bridge should be shifted east. The municipal dock at North Market St. should be completed according to the original plans as fast as river traffic requires it.

Electrification — Complete elimination of steam locomotives for smoke-abatement purposes is not necessary under present conditions and the electrification of the terminal system of St. Louis and East St. Louis is financially impracticable.

Man-Made Malaria in Road Construction

The importance of guarding against "man-made malaria" in highway construction, particularly in the South, is urged in a circular just issued by the United States Public Health Service. The circular states that the specifications for roads in the South "require that the culverts be so placed that they will completely drain all wet areas above the culvert entrance and that all borrow pits or excavations made along the roadways shall be filled or properly drained." Many southern states have enacted laws to this effect. The circular points out that if the matter is given attention in time "adequate drainage can be had with very little, if any, additional cost; whereas, if through carelessness or wilfulness the culverts are placed too high or the borrow pits are not properly drained the expense for later rectification may be very great." Finally, the circular states: "No road, however necessary for travel, can be called good if it interferes with proper drainage."

New River-and-Rail Terminals on the Mississippi

Truck Conveyor Bridge and Car Incline with Cradle Provide for Varying River Level—Two Concrete Docks with Cranes

LACK of terminal and interchange facilities on inland waterway routes is recognized as one of the principal reasons for the failure to develop extensive freight traffic on the large river systems of the United States, ranking next to the difficulties of extending joint rate territory and of an equitable division between rail and water carriers. It is of particular interest, therefore, to record the work of establishing river-and-rail terminals for the government's experimental barge service on the Mississippi and Warrior Rivers.

This waterway service was established during the war in order to supplement the carrying capacity of the railroads. It was soon evident that little commercial business could be handled or developed without facilities for interchange with the railways, but there were few river terminals properly constructed and equipped for such transfer between river craft and railway cars. To develop the Mississippi-Warior River service, therefore, funds were authorized by Congress in 1919 and 1920 for the construction of adequate terminals at St. Louis, Cairo, Memphis, Vicksburg and Mobile.

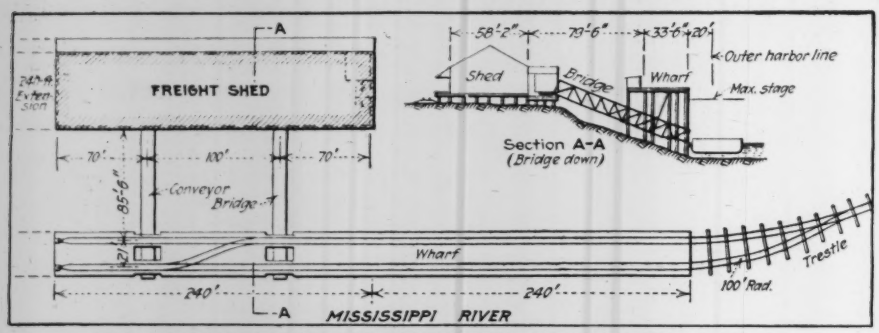


FIG. 1. CONVEYOR BRIDGE AND WHARF AT SOUTH ST. LOUIS, MO.

In 1920 the business of promotion and development of waterways was assigned to the War Department, which established the Inland and Coastwise Waterway Service to provide the necessary facilities and to supervise the organization and operation of the traffic. The design of the terminals was entrusted originally to the Board of Engineers for Rivers and Harbors, U. S. War Department. Plans for terminals at St. Louis, Memphis, Vicksburg and Mobile were then prepared under the direction of Capt. F. T. Chambers, civil engineer corps, U. S. Navy, as engineer of port facilities for this board. More recently, the Waterway Service has loaned money to the local authorities at Memphis, Vicksburg and New Orleans. The plans for terminals at these points have been changed, therefore, to meet the views of the local authorities and of the federal management of the Mississippi-Warrior service.

Package freight constitutes perhaps 25 per cent of the traffic at St. Louis, Mo., which is the northern and inland terminal of the Mississippi-Warrior River steamer and barge line service. The city has established a municipal dock, which is used to a large extent by this service. The dock is of reinforced concrete, 890 ft. long and 36 ft. wide, with its deck at El. 42 on the St. Louis gage or 4 ft. above the 1903 flood stage. A pile fender extends 1,300 ft. north of the dock, at which barges may be moored to await loading or unloading. There are two frame warehouses, 200 x 160 ft. and 125 x 140 ft., with a shed 240 x 25 ft. between warehouse and dock. Three trestles, two north and one south of the dock, provide connections with the St. Louis Terminal R. R. and the Chicago, Burlington & Quincy R. R. Barges lie directly alongside the dock and not at a wharf boat.

The dock was built in the water with its face midway between the inner and outer harbor lines, a fill being then made on the land side by a city dump, thus reclaiming about 30 acres of land now valued at $2,000,000. Freight handling equipment includes two gantry cranes with 5,000-lb. hoisting trolleys, a 30-ton and four 15-ton cranes, a motor-driven conveyor and a gravity conveyor. From Feb. 1, 1919, to Sept. 30, 1921, there were handled 169,750 tons of freight, 90,630 tons inbound and 79,120 tons outbound.

East St. Louis—In addition to this municipal dock the barge line has been using a leased railway terminal at East St. Louis, Ill. This latter consists of an incline running diagonally down the levee at a grade of about 2½ per cent, upon which travels a cradle with a horizontal deck carrying a railway track connecting with the incline track. The cradle is shifted up and down the incline by a locomotive, according to variations in the river level, so as to keep a depth of 9 ft. of water at the outer end of the cradle.

At the end of the cradle is moored a concrete car float or pontoon having track capacity for 17 cars. To the far side of the float is lashed a floating transit shed or wharf boat. Barges are moored to the wharf boat for loading and unloading freight. This unit is to be doubled.

South St. Louis—The Inland and Coastwise Waterway Service has built a terminal of a different kind for the extension of its business at South St. Louis, as shown in Fig. 1. A wharf of creosoted timber is connected to the railroad system on shore by a track on a creosoted timber trestle. In front of the wharf is moored a wharf boat. Two inclined bridges supported by the wharf and by the substructure of the transit shed at the top of the bank, carry endless traveling chains equipped with flights for the automatic transfer of 2-ton hand trucks between the wharf boat and the transit shed.

Each bridge has a wheeled platform at the inner or hinged end, and a counterweight supported at the outer end, the outer end traveling in a vertical plane just inside the face of the wharf for the accommodation of the bridge to the wharf boat at any stage of the river. The extreme variation between high and low water at St. Louis is about 44 ft.

For unloading a river barge moored at the wharf boat, empty trucks will be pushed upon the descending chain belt on one of the bridges and thus lowered to the wharf boat, whence they will be pulled by hand aboard the river barge and there loaded. The loaded trucks will then be pulled by hand to the ascending conveyor and automatically raised to the upper level. There the

trucks will be pulled by hand to the unloading point of the floor of the shed, for classification, or into the railroad cars at the rear of the shed for shipment. The contract for this was let in June, 1921, on an estimated cost of about $205,000.

Cairo, Ill.—A car transfer incline with traveling cradle was built by the Inland and Coastwise Waterway Service, and was provided with a car float and wharf boat, as at East St. Louis. The float consists of four concrete barges 266 x 36 ft. lashed together to form a floating unit 532 x 72 ft., on which three tracks are laid. The wharf boat or warehouse is 56 ft. wide over the guards. For loading grain into barges, arrangements have been made with an elevator company which has a belt conveyor extending to the water front.

Memphis, Tenn.—The only suitable site is on a berm below the steep bank of the river bluff and adjacent to the two railway bridges, as shown in Fig. 2. The city already has an extensive holding upstream from these

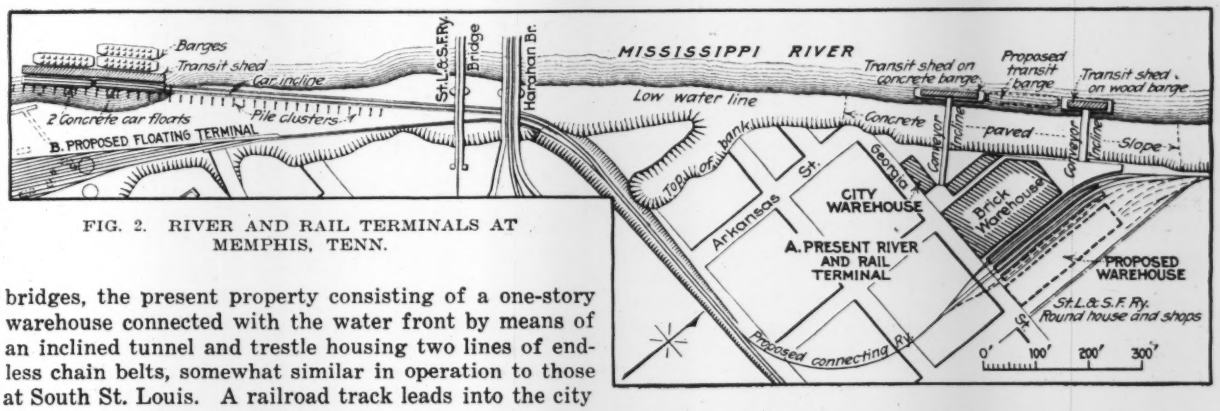


FIG. 2. RIVER AND RAIL TERMINALS AT MEMPHIS, TENN.

bridges, the present property consisting of a one-story warehouse connected with the water front by means of an inclined tunnel and trestle housing two lines of endless chain belts, somewhat similar in operation to those at South St. Louis. A railroad track leads into the city warehouse at the top of the bluffs.

The city proposes to buy an extensive tract of land near this terminal, at the top of the bluff, and also to acquire the berm at the foot of the bluff, where it is proposed to locate the government terminal. Every effort has been made by the Inland and Coastwise Waterway Service to co-operate with the city, so that instead of two isolated terminals there will be in effect one terminal, the parts of which will be connected by rail and roadway and will thus promote efficient operation. The city is acquiring the necessary land for the government terminal, but the barge line must continue to use the city terminal until the former is completed. The interchange terminal will be of the incline type, similar to that at Cairo, having rail connection with the city terminal. A belt line railroad connecting with all incoming traffic will also be built by the city.

Vicksburg, Miss.—Here the city has acquired a site and a contract has been let for a terminal similar to that at Cairo, except that the barge will be of steel, having three tracks and its own freight-handling equipment.

Since Mobile is the seaport terminus of the Warrior River transportation system, which taps the coal fields and iron and steel region of northern Alabama, there has been established on Blakely Island, opposite the city, a coal terminal for the government's experimental barge line. Fig. 3 shows the general character of the facilities as designed by the Port Facilities Section of the Board of Engineers for Rivers and Harbors. A creosoted timber wharf 500 ft. long flanks the deep water of the river and supports the front leg of a gantry crane carrying a 4-ton coal bucket. This plant has a capacity of 400 tons of coal per hour.

The gantry crane has a double function: (1) To take the coal from barges and transport it to the storage pile in the rear, and (2) to reclaim coal from this storage pile and deliver it into a hopper in the inshore leg of the bridge, from whence it passes over a weighing belt and then to a longitudinal conveyor belt running the entire length of the plant. This conveyor, by means of a tripper, discharges its load upon the belt of a ship-loading tower, which may be run freely underneath the bridge in order to reach any part of the water front. The plant is thus capable of storing and delivering several kinds of coal to any part of the water front.

Iron ore coming from Cuba and South America in ships will be transferred to a similar stock pile, or to river barges for transshipment to inland steel works. The plant as a whole is intended principally for an export coal terminal, but ship bunkering can be taken care of also. The cost of this terminal was a little over $400,000.

Since the present river service, with its barges and terminals, is experimental, the chief of the Inland and Coastwise Waterway Service has been willing to try several kinds of both floating and terminal equipment. Economical handling of water traffic on the Great Lakes has been mainly with bulk material in enormous quantities, such as iron ore, coal and grain. The Mississippi-Warrior service also handles both bulk and package freight. The manager of the Waterway Service makes the point that if the waterway is to compete with the railway, it is absolutely essential that the shipper of package freight should not suffer on account of barge transportation. In other words, he is entitled to a transfer of freight under covered storage in order that packages may arrive at their destination in as good condition as they would by railway freight car.

Ocean terminal layouts cannot be followed in the design of river terminals. For one thing, a large proportion of the package freight is packed less securely for domestic shipment than that going abroad, a large part of it being in paper cartons. This circumstance has an influence upon the river traffic problem, and it is partly on this account that it has been decided to try the endless chain conveyors for trucks at South St. Louis and the cradle inclines at East St. Louis. For packages of moderate size the conveyor is considered to have the advantage of continuous conveyance, which produces the greatest results. At the same time, it is not adapted

to the transportation of such material as lumber, steel rails, structural material in general, or bulk materials.

The height between extreme low water and flood conditions at all of these Mississippi cities is so great that under ordinary conditions the direct lift is not economical. However, it is necessary to provide direct lift for certain materials, as at the St. Louis municipal dock. The incline and cradle arrangement as used at East St. Louis and Cairo is considered to have the disadvantages of providing little space for classification and storage,

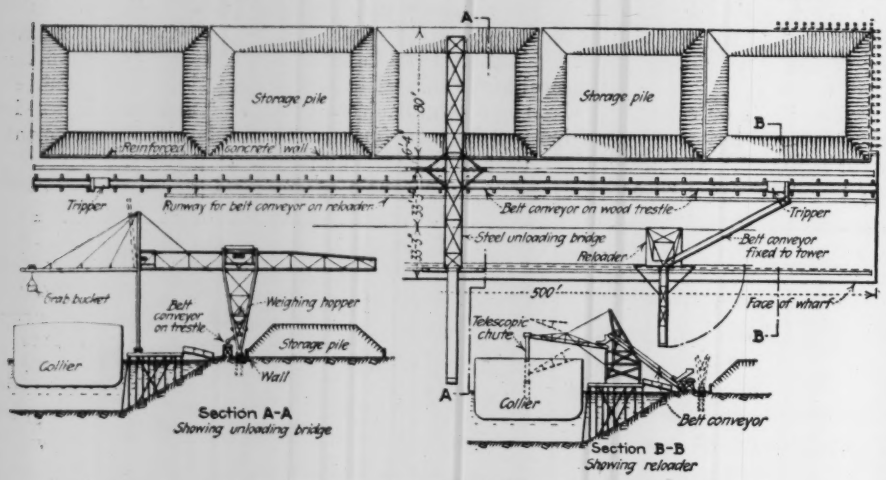


FIG. 3. COAL HANDLING AND STORAGE DOCK AT MOBILE, ALA.

and of requiring a considerable interval several times each day for making new set-ups of cars upon the car floats.

Raising Loch Raven Dam, Baltimore

Work is in progress on increasing the height of the Loch Raven dam for the Baltimore water supply to Elev. 240 above mean tide, or 103 ft. above bedrock. Relief openings were closed in April and it is expected that the work will be completed in June. An attempt will be made to hold the water to Elev. 210 until next autumn. It is hoped that by next spring the reservoir will be filled to Elev. 240, giving a storage capacity of some 23 billions. Provision is made for carrying the dam still higher, providing a water surface at Elev. 270 and a storage capacity of about 50 billion gallons.

The original Loch Raven dam on the Gunpowder River was completed in 1881. It was of stone and only some 25 ft. in height above the bed of the stream. By 1900 the original storage capacity of 510 m.g. had been reduced by silting to 78 m.g., although the silt had been removed from time to time by dredging from 1896 to 1900. In the latter year the city bought a suction dredge which was kept in operation until the fall of 1911, increasing the capacity from 78 to 178 m.g. It was calculated that the annual deposit of silt from 1891 to 1909 was 226,000 cubic yards.

From 1900 on the construction of a higher dam at Loch Raven was advocated by successive water engineers for the city. In 1910 a report on the whole problem of increased water supply was made by John R. Freeman and the late F. P. Stearns, with supplementary reports on the quality of the water and upon treatment by George C. Whipple and Allen Hazen respectively. The report advocated a new dam, a filtration plant at Montebello and other improvements. A dam with a crest elevation of 233½ ft. with provision for increasing the water level to 237½ ft. by the use of flashboards, so as to store about 21 billion gallons, was proposed.

The proposed dam was put under construction in 1912, at a point about a half-mile north of the old dam, but due to legal complications over riparian rights above the new dam, the structure was carried to Elev. 188 only, at which crest level it was completed in 1914, giving a total storage capacity of 1½ billion gallons, of which only some half could be drawn. The downstream face of the dam was stepped and bonding stones and grooves provided for carrying the dam to a higher elevation.

The present contract for increasing the height of the dam was let in April, 1921. At Elev. 240 the overall length of the dam will be 640 ft. and the spillway openings have a total length of 280 ft. In the present work, steel bars are being inserted in the downstream face, bent over just to meet the surface of the concrete, so that the dam may be broadened and raised as mentioned in the opening paragraph.

The work done in 1913-14 cost about $500,000, including cofferdams, etc., and some 45,000 cu.yd. of concrete. The work now under contract includes about the same amount of concrete and will cost about $525,000, bringing the cost up to $1,025,000 for the dam completed to crest Elev. 240.

William A. Megraw has been water engineer of Baltimore since October, 1919, and we are indebted to him for information regarding the present enlargement of the dam. It is expected that the work will be completed in June, 1922. It may be added that the Monebello filters are also to have their capacity increased from 128 to 203 m.g.d., and that new coagulating and settling basins and filtered water reservoirs will be built.

(See *Engineering News*, April 21, 1910, p. 470, for an article on the proposed enlargement of the Baltimore water-works, including figures from the Freeman and Stearns report, and Aug. 13, 1914, p. 231, for an article on the new dam. These articles were written by A. M. Quick and by Ezra B. Whitman, respectively, formerly water engineers of Baltimore.)

Vicksburg Waterworks Changes Correction

New boilers being erected for the water-works at Vicksburg, Miss., will be set for a flood stage of 57 ft. 4 in., instead of 40 ft., as mentioned in the article in *Engineering News-Record* of May 25, p. 870. This new elevation will be 2 ft. 4 in. above the crest elevation of the 1922 flood, according to J. A. Steele, Jr., manager of city water-works.

Tests on Molding of Concrete Under Pressure

Effect of Varying Pressures and of Curing in Different Periods of Air, Steam and Water Exposure

By Hugh M. Nelson
Engineer, Erie Concrete & Steel Co., Erie, Pa.

Some years ago the writer had charge of a series of tests for the Hydrostone Co., of Chicago, to determine the effect of pressure in molding and various curing methods upon the characteristics of concrete, particularly as regards strength, density, absorption, and ease of manufacturing. The results, not hitherto published, are abstracted herewith.

The aggregates were sand and gravel dredged from the old bed of White River near Indianapolis and the proportions determined on were 17 per cent cement, 26 per cent sand, and 57 per cent gravel, the water used being 47 per cent of the weight of cement. These proportions were kept constant by actual weight throughout. The test pieces were 6 in. in diameter and about 12 in. long, the mold in which they were made consisting of two halves of a hollow steel cylinder 14 in. high, the outside surface being tapered slightly to allow driving of tight fitting steel rings. A cast-iron plunger about $\frac{1}{8}$ in. smaller than the inside of the cylinder was used to transfer the pressure from the 100-ton press to the concrete in the mold. This mold allowed the easy removal of the test specimen immediately after molding.

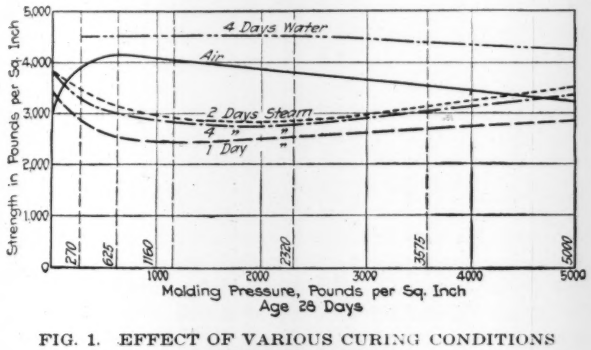


FIG. 1. EFFECT OF VARIOUS CURING CONDITIONS AND PRESSURES

The test blocks were made up in the mold and the pressure was secured by means of a 100-ton press, the pressure being read by a calibrated gage reading directly in pounds per square inch. With a few exceptions, 60 test pieces were made at each of the following pressures: 0, 270, 625, 1,160, 2,320, 3,575, and 5,000 lb. per square inch. Twelve of each kind were cured in moist air; twelve were cured one day in steam; twelve were cured two days in steam; twelve were cured four days in steam; and twelve were cured four days in water. Of each set of twelve four were tested at seven-day age; four at fourteen-day age; and four at twenty-eight day age.

The air cured blocks were placed on a damp floor, covered with cloth, and kept damp by sprinkling. The steam cured blocks were placed on wood racks in galvanized iron tanks, in the bottom of which was kept 3 in. of water at a temperature to insure a saturation of steam at all times. The water cured blocks were allowed to set for about twelve hours and then placed for four days in a tank of water kept at an even temperature. Twenty-four hours before testing, each cylinder was capped with plaster of paris and the following day pressure was gradually applied until failure occurred.

Effect on Strength—At the seven-day age the water-cured blocks were strongest for all molding pressures, air-cured next in strength, four-day steam-cured next, two-day steam-cured next, and one-day steam-cured the weakest. In all blocks cured by the different methods there is a tendency to gain strength with increase of molding pressure above a point near 270 lb. per square inch, the maximum strength being that of water-cured concrete molded at the 5,000-lb. pressure, the strength being 3,500 lb. per square inch.

At the fourteen-day age the order of strengths was the same as that given above for the seven-day age. At this age the water and moist-air cured blocks show the greatest strength at relatively low molding pressures and have a tendency to decrease in strength with increase of molding pressure, while the steam-cured blocks decrease in strength at the lower molding pressures and increase in strength from there as the molding pressure is increased.

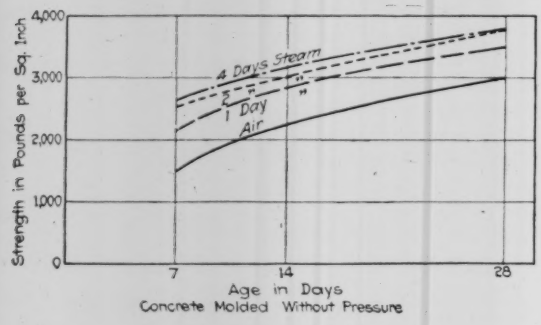
At the twenty-eight day age the tendencies were similar to those at fourteen days except that the two- and four-day steam-cured blocks passed the air-cured in strength at the highest molding pressure, 5,000-lb. per square inch. The twenty-eight day tests are the ones by which the results may best be judged and are shown by means of curves in Fig. 1. As an indication of the tendencies the curves for the no pressure and 2,320-lb. molding pressures, respectively, are given in Figs. 2 and 3.

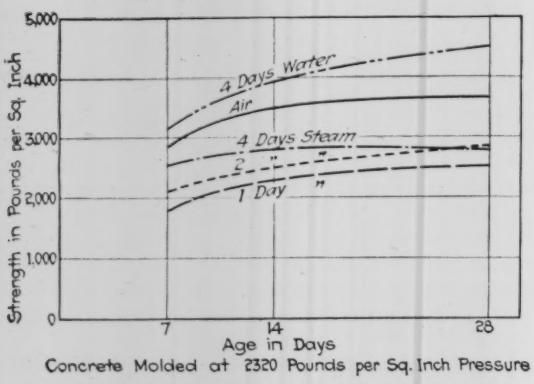
The tests show that the best curing method in all cases is that of submerging the concrete in water as soon as possible after molding and concrete cured by this method shows a steady increase in strength with age for each molding pressure. For the water-cured concrete there is practically no gain in strength with an increase of pressure from 270 to 2,320 lb. per square inch. and from the latter point of the maximum there is a slow decrease in strength with an increase of molding pressure. From the standpoint of strength alone there is no advantage in going above a few hundred pounds per square inch molding pressure when using the water-curing method.

The air-cured concrete, while second in strength for all pressures except the highest, shows a tendency to decrease in strength with increase of molding pressure above 600 to 700 lb. per square inch. Concrete cured in air is strongest when molded at about 600 lb. per square inch pressure.

The steam-cured concrete for all ages decreased rather sharply in strength for the lighter molding pressures and then increased in strength steadily with increase of pressure for all ages, concrete at 5,000 lb. per square inch molding pressure and cured by the two- and four-day steam methods passing the air-cured concrete in strength at the twenty-eight day age. The twenty-eight day tests on concrete cured by the steam method do not show a strength at any pressure equal to that of the no-pressure concrete cured by the same method. Also the steam-cured no-pressure con-

crete shows a steady increase of strength with age, while the steam-cured pressure concrete strength curve shows a marked tendency to flatten above the fourteen-day age and indicates only a very gradual increase of strength with increase of age. A study of the twenty-eight day tests shows however that in all probability the steam-cured concrete molded at some pressure above 5,000 lb. will attain a strength equal to those





FIGS. 2 AND 3. TYPICAL CURVES FOR TWO MOLDING PRESSURES

molded without pressure and at some higher pressure surpass the strength of the latter. However such high pressures in molding concrete products of any size are not feasible in commercial practice.

Physical Effects—The 625-lb. pressure blocks came from the molds slightly roughened by surface moisture and had a rubbery nature, bending quite noticeably without cracking. With increase of molding pressure the concrete became drier, smoother and more brittle, a couple made at a pressure of 7,150 lb. being so hard and brittle that they could not be removed from the mold without breaking. The concrete blocks molded at pressures from 1,500 to 1,800-lb. pressure had better surfaces, were more easily removed from the molds, and were better from the standpoint of handling immediately after molding than those made at higher or lower pressures.

Study of the effect of molding pressure on weight indicated that the weight per cubic foot increased from about 152 lb. at zero molding pressure to about 159 lb. per cubic foot at 270-lb. molding pressure, and that the weight remains practically constant for increased molding pressures.

Study of the effect of molding pressure on absorption showed that for concrete of the mix used and molded without pressure the absorption is from 6 to 6½ per cent and it drops sharply with pressure to from 3½ to 4½ per cent at a pressure of about 1,000 lb. per square inch, where it remains practically stationary with increased molding pressure for air, water, and one-day steam curing methods. The moist air blocks on the average show the least absorption. For the two- and four-day steam-curing methods there is a small increase in absorption for pressures beyond 1,000 lb.

In the testing of the blocks the air- and water-cured concrete was hard and firm, and destruction occurred suddenly with considerable noise and flying of fragments, while the steam-cured concrete was less hard and firm, failure taking place more gradually. The former also showed an actual shearing of the coarse aggregate in failure while the latter rarely showed that condition, the large aggregate breaking loose rather than shearing.

Conclusions—From the results of the tests it is apparent that the strength, uniformity, absorption, density, and physical characteristics of concrete may be improved by molding under pressure, and it is obvious that the water content largely controls the strength, there being sufficient water retained at low pressures and not sufficient water retained at high pressures for proper hydration.

Concrete molded at relatively low pressures and cured by the moist air or water method is superior in strength and physical characteristics to concrete molded at high pressures.

For steam-cured concrete made under pressure there is actually a loss in strength with molding pressures up to about 1,000 lb. per square inch and from there on a slight increase in strength with increase of molding pressure with an indication that at pressures so high as to be impracticable the strength may equal that of no-pressure concrete. At such high pressures however it is doubtful if there would be sufficient water for proper hydration and the strength attained would be due more to the great pressure used in molding than to cementation. It is doubtful if such strength would be permanent or the physical characteristics of the concrete desirable.

French Railways Try Gasoline-Driven Cars

Corresponding to the experiments now being conducted on American railroads, *The Engineer*, London, tells us that the French State Rys. have also been carrying on experiments to ascertain the possibility of using gasoline-driven motors on lines with limited traffic. The trials are reported to be satisfactory so far. The French appear to be using their motor-driven vehicles as locomotives, for it is reported that a 60-hp. motor weighing 14 tons and drawing a car weighing 10 tons easily reached a speed of more than 30 miles an hour, this being but slightly reduced when a second car was added. It is estimated that on local lines of standard gage motor traction would enable a saving of from 5 francs to 10 francs per kilometer, the present figure for steam traction being more than 14 francs. The Minister of Public Works, who has been following the experiments, has sent a circular to all prefects of departments asking them to study the possibility of applying gasoline traction to the departmental railways. On many of the smaller local lines it is estimated that operating costs may be halved by this means.

Mechanical Equipment as a Factor in Building Design

Structural Engineer Must Provide Adequately for Varied Service Plant with Complicated Piping and Cable Systems

HOW structural design of large buildings of the office, hotel and apartment class is influenced by considerations of the various mechanical equipment required for such buildings was the subject of a recent paper read before the Western Society of Engineers by H. L. Clute, chief engineer of the Arcade Steam Heating Co., Chicago. An abstract of this is given below:

Mechanical equipment of a building is that part which furnishes such utilities as water, gas, electricity, steam, conveyance, ventilation and refrigeration. In preparing the preliminary and structural design of the building it is necessary to have a general conception of the equipment to be provided, or when too late it may be found difficult to make suitable provision and arrangement.

Three classes of equipment are practically common to all buildings: plumbing, electric wiring and steam. Plumbing includes drainage, water supply, gas and often vacuum cleaning. Wiring is for light, power, telephones, signal system, clock system, telautograph and special purposes. Six semi-common classes are elevators, ventilation, electric generation, refrigeration, pneumatic tubes and sprinkler system. Special installations are required to serve hotel kitchens and laundries, theater stages and similar cases. Each installation may be divided into three classes: Apparatus, conductors and accessories.

To illustrate the complexity of the equipment, the water installation may include the following: Two mains for cold water (at city pressure and high pressure); two hot-water mains each with supply and circulation return systems; a main and return for drinking water; brine supply and return mains, and high and low level drainage and storm water mains. Steam distribution may include high, medium and low pressure service, each with supply, return and drip mains. In a typical example there may be thirty systems of horizontal pipe mains each with five to ten risers or vertical lines through the building, and each riser with four to forty branches. These mains are at different levels, with risers extending either upward or downward. Interspersed with these pipes will be from five to twenty duct lines, with branches, pneumatic tubes and electric feeders.

Structural provisions for such equipment include ample floor area for machinery and apparatus, continuous horizontal and vertical spaces for mains and risers, space for offsets for branches, and facilities for convenient operation and maintenance. In the ideal condition all the mains would have the shortest possible leads from producing apparatus to utilizing apparatus, but paralleling the main axes of the building. But in the actual condition the equipment is twisted and distorted to keep it out of the way and out of sight. This arrangement of the equipment to meet actual conditions with efficiency and economy is sometimes one of the principal problems of the mechanical engineer.

Pipe Mains and Basement Girders—Piping is grouped usually at basement ceilings more than at any other place, and here trouble is caused by deep beams and girders. In general the profile of the main must be a straight line with only a slight inclination from the horizontal. For this reason the entire main must be below the bottom of the deepest girder, except when some special provision is made. One building has most of the girders 26 in. deep and some 32-in. deep. As the mains must be below the latter, this brings them far below the ceiling and makes an unsightly arrangement.

This problem is one for the structural engineer. Of course the economical section of a girder is a deep one. To provide the necessary strength by increasing the width of girder instead of the depth in order to maintain a uniform depth would involve extra expense. But in certain cases this construction expense would be warranted by the saving in expense for mechanical installations and by the greater convenience and reliability in the operation of the mechanical plant. Pipes are sometimes laid through holes in the center of steel girders, but with reinforced concrete there would be the liability of interference with the reinforcing bars, especially where the girders are of varying depths.

Pipes and Floor Framing—In the upper part of the building, pipe mains are laid usually above suspended ceilings, but here also the depth of beams and girders is a factor. In some cases a certain depth of furring has been assumed below the ceiling panel and is found to be insufficient for the piping. Then some method of increasing the depth must be found. Sometimes the pipes are carried down and around in cornices and false beams across the panels. This may be necessary but is objectionable in requiring an excessive number of turns or bends in the piping. Where a floor filling of not less than 5 in. depth is available certain mains may be laid in this fill.

A double floor at some point in the height of the building is very desirable, especially in hotel buildings where there are a certain number of special floors in the lower portion and typical or uniform floors above. I believe that in time every hotel building will be designed with a double floor construction above the special floor and below the typical floors, because all of the pipes and risers coming down the upper part of the interior of the building must be disposed of. They must be offset individually and carried down columns and in partitions and special places with various crooks and turns, or they must be collected together at mains in a floor space below the typical floors. To permit free access this space should be at least 3 ft. high.

One of these floors is the main load-bearing floor and the other is an auxiliary floor of short spans, either suspended from the main or carried above it on struts. The tendency is to place the auxiliary floor below the main floor, with the idea that all the deep beams and girders and trusses may be carried in this space and leave a flat ceiling below, whereas if the main floor were below and the auxiliary floor above those deep beams and girders would be exposed on the ceiling. This is a mistake. As stated in connection with basement mains, those beams and girders will not permit the passage of pipes, so the depth of the pipe space should be the required amount below these beams, except that under the beams it may be reduced and workmen may crawl under beams and find a working space in the panels. In general it is best to place the working floor below and the auxiliary floor above, as the space between the girders will then be available to add to the height of ceilings in the rooms below.

Pipe and Cable Shafts—A pipe shaft of ample size for riser trunks should be provided. A width of 3½ ft. is generally sufficient if the length is great enough to accommodate all the pipes in one layer. This is usually placed alongside of the smokestack, and a good arrangement is to use a beam or girder at the side of the smokestack for a walkway in the shaft, building the shaft of sufficient additional width to place the pipes.

Electric cables and feeders are carried up through the building at the centers of approximately equal areas, so that the distances from the cable shafts to the sides of these areas will be not over about 80 ft. If the entire area of the building is divided into as many units roughly of that size as required, and a cable shaft provided in each one it is a very adequate provision. It is seldom the case that the cable shaft is carried up continuously from the basement or lowest floor through the building, but it should be built in this way.

Steam risers are usually near the outside walls and plumbing risers at the interior of the building. The former may be furred in with the columns or carried up in chases. With skeleton construction it is usually difficult to provide chases, but some structural engineers are using a construction in which the spandrel beam is 4 in. thinner than the thickness of the wall, the inside face of the beam being set

back 4 in. from the inside face of the wall. This permits of carrying up a chase through the skeleton framing and gives an excellent opportunity to conceal the steam risers. Many buildings of the better class are now having these pipes concealed.

Interior risers are placed usually in shafts large enough to give working space for a man in maintenance and repair work. A width of 28 in. is about the minimum for a plumbing shaft. Sometimes these shafts are made continuous, or without the floor fill at each floor, and are then used as the exhaust shafts for the toilet rooms. If the floor is open, steel doors are required at each opening for access. That is fireproof construction. If they are closed at each floor ordinary wood panels may be provided. If they are left open the entire area has to be framed, whereas with the closed shaft the pipes may be carried up in sleeves between the reinforcing rods. It is always a question as to which type is best.

If the pipes or risers are furnished in special non-accessible shafts they are either at the columns or in such special locations as may be found here and there. If they are at the columns there is always the question of space required; in addition to the amount required by the pipes there is always a beam carried out from the center of the column, leaving the only available space at one side of this beam. It would be an advantage if there could be some way of designing twin beams where there are a number of shafts of this kind, especially in office buildings. That is, beams side by side, so that the extra space inclosed with the columns would be entirely utilized for pipes. This plan would add very little to the size of the column. Where the pipes are placed in various shafts wherever it may be convenient, no structural provisions are necessary.

Elevators — With electric elevators the machines are located usually over the shafts. Beam framing at the floors carries the guides and must be designed for vertical loads imposed by the emergency brakes gripping the guides. Pits require a depth of 3½ to 4 ft. for spring buffers or 6 to 8 ft. for oil buffers and 9 ft. for compensating cables. In fact elevator manufacturers are always asking for deeper pits. This involves drainage systems, as the pits are rarely watertight.

Boiler-Room Space — Space provided for the boilers is found frequently to be inadequate for proper boiler capacity. Two boilers are preferable to one of equal capacity in order to provide for cleaning and reserve. Three boilers are preferable to two for plants of over 15,000 sq.ft. of radiation. Headroom is often insufficient owing to a desire to limit the depth of excavation, but there should be ample space over the boiler to give free access for inspection of safety valves, automatic checks, main valves and other accessories. For cast-iron, return tubular and water-tube boilers the minimum headroom may be taken as 9, 15 and 28 ft. respectively, although some water-tube boilers require 32 ft. and some may be as low as 22 ft. Thus the type and size of boiler are factors in the building design.

Space must be provided for access to all sides of the boiler and for a firing floor in front. This latter may be from 5 to 10 ft., the latter being sufficient for withdrawing a mechanical stoker. For protection of the floor above the boiler room, an insulated ceiling is preferable to air circulation in the space over the boilers. Where coal is fed by gravity from a bunker to the mechanical stokers the minimum height from boiler-room floor to bottom of bunker will be about 12 ft. Allowing a 40 deg. slope for the bunker bottom, this gravity feed system will require a basement or sub-basement height of about 30 ft. When this is not practicable, the main bunker may be on the boiler room floor with a conveyor carrying the coal to an auxiliary bunker which feeds the stokers.

Smokestack—The area provided for this will depend upon the boiler capacity together with the thickness of insulation and the 4-in. clearance space required by the city ordinance. Since its height varies with expansion and contraction it must be supported at one point, either on a special foundation or on a girder framing in the superstructure. The latter case requires the special attention of the structural engineer.

Engines—Where engines and generators are installed a height of 15 ft. will usually be sufficient to provide space for the large amount of piping that must be placed along the ceiling. Engine foundations must not be in contact with column foundations or floors, a joint filled with elastic packing being used in the floor.

House Tanks—Every building of the class noted requires house tanks sufficient for 20 to 60-minute supply in emergencies. The Morrison Hotel has two 10,000-gal. gravity tanks in the roof pent house for domestic supply. Other buildings have two 4,000-gal. tanks. With two tanks one can be cleaned while the other is in use. To provide support of such tanks may involve special structural design.

Air Conditioners—These are often required in connection with the supply system of ventilating equipment and should be placed as nearly as possible in the direct line of travel from the intake to the ventilated room. The apparatus includes a fan, motor, air-washer and heaters, requiring usually a length of 26 ft. For upper floors, the conditioners may be placed in an interior room which is made available by leading to it an intake duct over the ceiling. A good location in a large building is behind the elevators, the rear wall of the elevator shaft being set back far enough to accommodate the conditioner units, with direct intake through the wall to the unit.

Asphalt Used to Resurface Worn Brick Pavement

Strengthening of Binder Course Shown to Be Desirable in Oil City, Pa.—Special Methods Along Car Tracks

By D. A. Grant

President, The D. A. Grant Co., Inc., Contractor, Oil City, Pa.

MANY of the smaller cities of western Pennsylvania are confronted with the problem of restoring worn-out brick pavements varying in age up to 30 years. Economy demands a means of repaving at minimum cost and a pavement of some degree of permanence. The expense of this work must be borne entirely by the cities, since the original paving was done by property assessment.

To remove the old pavement and lay a new foundation to withstand present traffic, utilizing the existing curbing, would involve the cost of excavation and hauling of the old brick and the excavation of sufficient gravel and subsoil to permit the placing of the new foundation. This is a necessary first cost before the expense of a new pavement is considered. By the removal of the brick and the underlying gravel or stone a consolidation that can only be duplicated by years of traffic is destroyed. These bricks have been slowly bedded during a period of many years of traffic, always increasing in weight and volume, so that they are now on a permanent base of thoroughly consolidated sand and gravel, equal, if not superior in some cases, to the usual concrete base on a freshly prepared sub-grade. To waste this foundation would be an economic loss.

Resurface with Asphalt—Resurfacing with sheet asphalt or other asphalt wearing surface is a solution that has been practised by a number of cities for many years. The usual practice is to sweep the brick, remove all loose dirt and then sprinkle or splash asphaltic cement over the surface, employing an old broom or brush for the purpose. The binder course is then laid at a uniform thickness over the old brick, when the pavement is sheet asphalt, but if bituminous concrete,

FIG. 1. WIDE STRIP OF BITUMINOUS BASE
Used where car tracks were on almost same level as adjacent pavement.

the wearing surface is laid directly on the brick. Often this work has been done without any special effort being made to first fill the existing depressions and bring the foundation to a fairly uniform cross-section before laying the pavement in a uniform course.

Inasmuch as the surface of these old brick pavements is usually made up of a series of small waves, it is necessary in laying a somewhat flexible wearing surface, to guard against any movement of this surface that might naturally take place from the crest to the trough of each wave.

In the resurfacing of old waterbound macadam roads with bituminous pavements it has long been the practice to bring the old macadam to a true cross-section by scarification of the lumps followed by the addition of new material. This should also be the practice in case of resurfacing brick pavements. Although it is not practical to remove the high areas, it is quite a simple matter to fill the low areas with asphaltic concrete, which may be thoroughly compressed. A dense asphaltic concrete is much to be preferred for this purpose to the ordinary binder mixture as it forms a stable patch, thus reinforcing the foundation.

Binder Strengthened—It is highly desirable to strengthen the binder course so that it will possess material slab strength to bridge over new service openings and any weak areas that might exist in the base. This may be accomplished at a low cost by the addition of a small percentage of limestone screenings to the binder mixture and increasing the asphaltic content but slightly.

Most of the binder stone used is a one-size quarry product, so that filling the larger voids by means of the coarser particles of the screenings makes the mixture dense. A more important advantage is gained from the use of screenings in the quarry dust contained, which acts as a filler. While many engineers have been favorably impressed with the idea of using a filler in the binder mixture, it has rarely ever been so employed. Certainly the vast improvement in stiffening and toughening the binder that can be so easily and cheaply accomplished justifies the incorporation of this additional element in the mixture. Screenings can usually be obtained more cheaply than sand and stone, so that there is no cost added in their use.

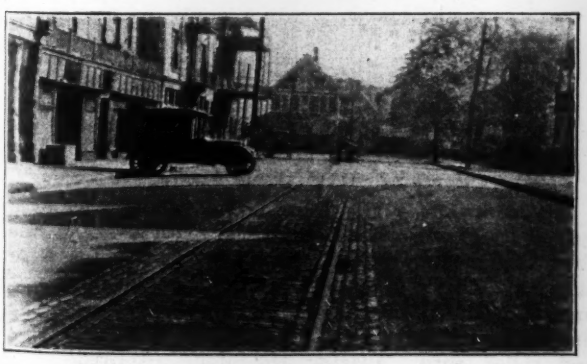


FIG. 2. RESURFACED PAVEMENT, OIL CITY

An asphaltic concrete binder mixture that has proved satisfactory is as follows:

	Passing	Ret. On	Percentage	
Stone	1½ in.	⅜ in.	60 to 70	
Screenings	⅜ in.	To dust	15 to 25	25 to 35
Sand	10 Mesh	..	10 to 15	
Asphaltic cement	..	..	4 to 6	

To strengthen further the binder course it is excellent practice to increase the thickness of the course to 2 in. and reduce the wearing surface to 1 in. This makes practically no change in the cost of the finished pavement over the old accepted 1½-1½-in. standards and certainly is a superior pavement. The feasibility of the employment of a sheet-asphalt pavement composed of 1 in. of wearing surface and 1½ in. of binder, has been too thoroughly demonstrated to question. The Pennsylvania State Highway Department has laid over 625,000 sq.yd. of that standard. The only difficulty in such standards of thickness is that in very cold weather the thinner course of wearing surface chills rapidly and a rough surface may result. This occurs at temperatures, however, at which asphalt pavement should not be laid, regardless of standard of thickness.

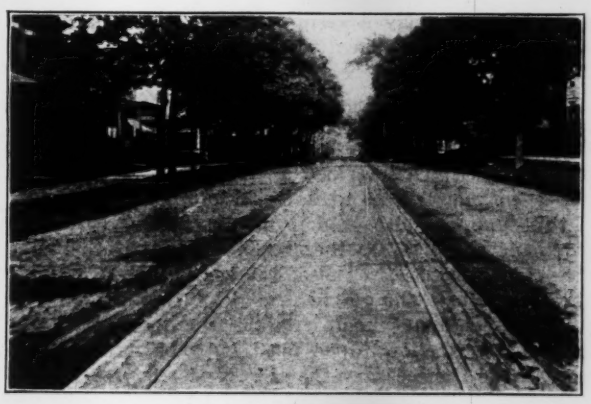


FIG. 3. BITUMINOUS CONCRETE SUPPORTS TRACK LINERS

If a bituminous concrete binder mixture of the type described is provided for, it may be used to good advantage in increased thicknesses in places where it is necessary entirely to renew the base, such as over service openings and at intersections where it is necessary to remove the brick in lowering the grade.

During the summer of 1921 a contract was let for the repaving of a number of old brick streets in Oil City, Pa., with sheet asphalt. Specifications called for 1½-in. wearing surface and 1-in. binder, A. S. M. I. specifications. All but one of the old brick pavements were laid on a gravel base; the exception was a concrete base of rather poor quality. In all cases the surface was distorted, irregular, and contained numerous potholes. Provision was made in the specifications for extra binder and asphaltic concrete for building up low

areas and for providing a base where the brick were removed at intersections.

Asphaltic concrete was prepared from a mixture of gravel and slag, screenings, sand and Texaco asphaltic cement. Slag and gravel were found to give equally good results as coarse aggregate, although the former required an abnormal amount of asphaltic cement. Local bank sand and gravel were used.

Along Car Tracks—In order to meet the grade of the car tracks with the asphalt surface it was necessary to remove several courses of brick adjacent to the track liners. The channel thus formed was filled with asphaltic concrete laid at a height of 1¼ in. below the top of the liners, allowing the wearing surface course to be kept slightly above the brick. No binder was laid on this strip of bituminous concrete.

Where the car tracks were high only a strip of bituminous concrete of sufficient width to permit the laying and locking in place of the brick liners was used, as shown in Fig. 3. On East First St., as shown in Fig. 1, the car tracks were on almost the same level as the adjacent pavement. It was therefore necessary to remove brick and lay a strip of about 4 ft. of bituminous concrete, and crown the pavement slightly toward the car tracks.

A bituminous concrete of great density, composed of gravel, screenings, sand and asphaltic cement, weighing about 4,000 lb. per cubic yard compressed, was used for this purpose. This formed a base so rigid that there can be no question as to its serviceability. A mixture of this type was also used to fill depressions in the old pavement and true up the cross-sections before laying the binder course. These patches were thoroughly compressed and allowed to cool prior to the laying of the binder course. Small irregularities in the old brick surface, too shallow to be filled with bituminous concrete, made it necessary that the binder course be considerably in excess of the specified 1 in. thickness.

In the first work of this character, done under the supervision of the writer, there was considerable movement noted in the binder course during the passing of the roller. This was true even after the material had been thoroughly cooled, and was due to the irregular and vitrified surface of the brick pavement. As a result of this condition, when the wearing surface was being rolled the unstable binder caused cracks to develop in the wearing surface course which were very hard to restore.

As a remedy for this condition the addition of filler to the binder mixture was resorted to. This was accomplished by the incorporation of about 20 per cent of screenings, ⅛ in. to dust, in the mixture, and reducing the sand content to 15 per cent. The result was quite gratifying. The binder so prepared could be rolled to any extent and suffered no ill effects when subjected to traffic from 5-ton trucks.

In the laying of sheet asphalt pavements too little stress is laid on the design and preparation of the binder mixture. Many failures that have been attributed to inferior wearing-surface materials or mixture can be traced to the binder course. There seems to be no reason why this portion of the pavement should not be a true asphaltic concrete, so designed as to possess density, rigidity and stability.

In Oil City several rough, irregular pavements, have been transformed to smooth, silent boulevards by the methods above described.

Man-Hour Cost of Heavy Paving, Lockport, Ill.

Side-Hill Streets Graded, Parked, Paved and Drained—Man-Hours Itemized for Each Kind of Work

BY CHARLES E. DELEUW
Kelker, DeLeuw & Co., Engineers, Chicago

TIME costs were kept last summer on about 47,300 sq.yd. of concrete paving constructed at Lockport, Ill., by the R. F. Conway Co., Chicago, under the direction of the writer's firm as engineers.

Lockport is situated on one side of the Desplaines River Valley. The streets run parallel with, and perpendicular to, the line of the river. Half are side-hill streets, and on them heavy cuts were necessary. For that reason, the excavation is proportionately greater than on the average paving job in the Middle West. The specifications required the grading to be done from sidewalk to sidewalk. The grading of the parkways also appears as a substantial item in the cost. These parkways were 25 ft. in width, were sloped uniformly from sidewalk to curb, and a carefully finished surface was required similar to that of the roadways after fine grading. The widths of the roadways were 20 ft.

There were no other unusual factors which are worthy of note. The weather conditions were average. Labor was plentiful and there was a willingness to work which contrasted favorably with conditions in 1919 and 1920. The rates paid were abnormally high, and for that reason the data have been prepared to show man-hours per unit of quantity. Data in this shape are very useful. By using the existing rates for the various classes of labor, it is possibly to work up an accurate estimate at any time. The greatest variable which affects cost data is eliminated, and the writer is convinced that if engineers and contractors habitually presented their cost records in this shape, the profession would greatly profit.

Excavation—The total grading was 34,000 cu-yd., for 47,300 sq.yd. of pavement. Two Koehring excavators did the heavy work and the grade was shaped up with slip scrapers. The soil was clay and glacial drift. The quantities handled and the man-hours required for each kind of work were as given in Table I.

TABLE I—LABOR HOURS PER CUBIC YARD FOR 34,000 CU.YD. OF EXCAVATION GRADING FOR PAVEMENT

Item	Rough-Grading Hours per Cu.Yd.	Fine Grading Hours per Cu.Yd.	Fine Grading Hours per Sq.Yd.	Trimming Parkways Hours per Cu.Yd.	Total Hours per Cu.Yd.
Foreman	0.0073	0.0099	0.0071	0.0109	0.0281
Excavators	0.0374	0.0042	0.0030	0.0012	0.0428
Operator	0.0447	0.0046	0.0033	0.0014	0.0507
Helper	0.0323	0.0008	0.0006	0.0002	0.0333
Laborers	0.2374	0.1622	0.1164	0.1958	0.5954
Teams	0.1216	0.0426	0.0306	0.0324	0.1956
Trucks	0.0004	.....	.....	.....	0.0004
Water boy	0.0012	0.0059	0.0042	0.0032	0.0103
Watchman	0.0321	0.0009	0.0006	0.0003	0.0333

Macadam Base—The 5-in. broken stone base was spread by opening the tail-gates of the truck and was then smoothed by hand. Screenings and water were added and this course rolled until a smooth finish was produced and a wave of mortar appeared in front of the roller. It was then covered with 1 in. of stone and rolled once. Placing the stone required 1,313 laborers' hours or 0.0277 labor-hours per square yard.

The time cost of he 5-in. macadam base was:

Item	Hours Per Sq.Yd.
Foreman	0.0171
Laborers	0.2390
Teams	0.0096
Rollerman	0.0224
Roller	0.0217
Receiver	0.0086
Watchman	0.0175

Asphaltic Top—A 2-in. asphaltic concrete top, with a dust finish, was required. A railroad crane with a clamshell bucket handled the material to a two-car Cummer plant. Crude oil was used as fuel and the consumption was approximately ½ gal. a square yard for 47,300 sq.yd. The total amount of top was 10,139,000 lb. or 214.4 lb. per square yard. The average haul in five-ton trucks was 3,500 ft. The costs including the labor of erecting the plant were:

Item	Hours Per Sq.Yd. at Plant	Hours Per Sq.Yd. on Street
Foreman	0.0087	0.0044
Engineers	0.0308	.....
Fireman	0.0423	.....
Laborers	0.1213	0.0314
Watchman	0.0017	0.0042
Water boy	0.0054	.....
Rollerman	.....	0.0119
Rollers	.....	0.0119
Rakers	.....	0.0202
Tampers	.....	0.0106
Smoothers	.....	0.0108
Trucks	.....	0.0150

Drainage Structures—New drains, sewers and inlets and new and altered manholes and catchbasins constituted the drainage structures.

A total of 24,200 lin.ft. of 4-in. *drain pipe* was laid with open joints 30 in. below curb grade. The excavation was carried about 6 in. below the excavation for the curb and cinders were backfilled 6 in. over the pipe; the balance of the backfill was earth. Vitrified "seconds" were used. The labor hours per lineal foot were:

Foreman	0.0008
Laborers	0.4020

About 4,540 ft. of 8-in. *sewer* was laid, with mortar joints, in a 30-in. trench. The labor hours per lineal foot were:

Foreman	0.0064
Laborers	0.6410

There were 192 *inlets*. These were 17 x 24 x 5-in. cast-iron boxes, with grates, set in 1:2:4 concrete foundations about 24 x 24 x 18 in., in which 8-in. elbows were embedded. The labor hours per inlet were:

Skilled laborers	0.735
Common laborers	9.375

A total of 69 concrete *manholes* and 60 concrete *catchbasins* were adjusted by lowering and retopping with brick. The labor hours per unit were:

Item	Manholes	Catch Basins
Skilled labor	3.10	1.—
Common labor	9.17	2.400

Two new *catchbasins*, 4 x 7 ft. were built of brick in mortar; the labor hours per catchbasin were:

Skilled labor	8.0
Common labor	48.00

Concrete Curb—A total of 38,800 ft. of 6 x 8 x 24-in., 1:2:3 concrete curb was constructed in a 12-in. trench. There was a mortar coat on the top only. The labor hours per lineal foot were:

Foreman	0.0191
Carpenter	0.0172
Finisher	0.1111
Engineer	0.0110
Engineer's helper	0.0048
Concrete laborers	0.1552
Excavation laborers	0.2952
Backfilling laborers	0.0402
Teams	0.0084
Watchman	0.0191
Waterboy	0.0098
Mixer	0.0107
Truck Tractors	0.0214

Wall Construction—There were 63 cu.yd. of 1:2:3½ concrete in a retaining wall 110 ft. long and averaging 5 ft. in height. The labor hours per cubic yard were:

Foreman	0.730
Carpenter	1.015
Finisher	1.078
Engineer	0.222
Mixer	0.222
Truck tractor	0.222
Laborers	5.460

Unloading and Hauling—The materials included stone, sand, cinders and screenings and sewer and drain pipe. The stone and screenings were hauled direct from the quarry and the sand and cinders from a team track. The volume, haul and labor hours per cubic yard for each material were:

	Stone	Cinders	Sand	Screenings
Volume, cu.yd	9,290	350	6,000	1,200
Average haul, mi	8	0.75	0.75	8
Hours per cu.yd.				
Foreman	0.0009	.....	.....	.....
Laborers	0.0138	1.495	2.120	.....
Trucks	0.4325	0.357	0.547	0.267

The drain tile and sewer pipe were hauled ¾ mile from a team track and placed along the trench. The labor hours per lineal foot for each were:

Item	Sewer Pipe	Drain Pipe
Foreman	0.0055	0.0008
Laborers	0.0247	0.0121
Trucks	0.0020	0.0023
Teams	0.0038	0.0013

All hauling from the quarry was by five-ton trucks largely over a concrete road, with a 10 per cent maximum grade.

Heavy Decline in Jersey City Sewer Bids

A REMARKABLE decline in bids for the same sewer construction job in Jersey City has taken place since 1920, a contract for the work having recently been let for $197,898, compared with lowest bids of $644,000 on Aug. 10, 1920, and $335,454 on Oct. 19 of the same year. The engineer's estimate before the first bidding was $237,911. The very high first bid is attributed to an exaggerated allowance for unsettled labor and material markets. The following information as to the nature of the work has been sent to *Engineering News-Record* by C. A. VanKeuren, chief engineer, Department of Streets and Public Improvements, Jersey City. The Fisk St. sewer is 17,865 ft. long, of which 8,800 ft. is 18-in. vitrified pipe; 8,465 ft. is 24- to 81-in. circular brick sewer and 600 ft. is 102-in. steel pipe. The brick sewer is divided by sizes as follows: 24-in., 4,600 ft.; 30-in., 925; 48-in., 1,140; 78-in., 840; 81-in., 960. The average cuts are about 10 ft. for the 18-in. pipe sewer, about 10½ ft. for the brick sewers and about 7 ft. for the steel pipe. There will be rock excavation, 1,000 cu.yd.; rubble masonry, 100 cu.yd.; concrete, about 200 lin.ft.; piles, 8,000; capping, 18,000 ft. B.M.; flooring, 33,000 ft. B.M.; sheathing, 50,000 ft. B.M.; receiving basins, 24, besides two which must be rebuilt. The contract was awarded April 25 to the lowest bidder of April 18, the Public Service Production Co., for $197,898 or 2 per cent under Mr. VanKeuren's revised estimate. The next higher bid was 7 per cent above the revised estimate.

American Society for Testing Materials Meets

Heavy Program and Record Attendance — Research Given Special Attention in Spite of Increased Volume of Specification Work—Interesting Discussions of Fatigue and Impact

STUDY of materials and test methods for the first time in the history of the American Society for Testing Materials took precedence over specification work at this year's meeting, held at Atlantic City last week. The development of standard specifications, while of greater volume than ever before, assumed the position of virtually routine work. This change is the more important as it is a deliberate movement, initiated two years ago by J. A. Capp, then president, and therefore may be considered as a definite alteration of the society's course rather than a sporadic phenomenon.

The most prominent single items of the program so far as the new phase is concerned were two active sessions in which impact testing of materials and fatigue phenomena were discussed. The former followed upon a specially arranged symposium of papers and methods of impact testing, while the latter centered around a paper reporting the results of the Illinois fatigue investigation which has been in progress during the past two years under the direction of Prof. H. F. Moore.

With the new emphasis laid on study of materials, the program of the meeting became enlarged to the point of requiring twelve sessions, in which about 70 papers and reports had to be dealt with. In order to crowd these into the four days of the meeting it was necessary to hold duplicate sessions during two periods. The program as a whole was heavy because of its length and the range and importance of its contents. It is possible that the society will soon go over to the plan of holding two meetings a year, in order to reduce the meeting programs to workable length.

Some Specification Results—While a large part of the committee work was too specialized for mention here, it is possible to indicate briefly some of the results affecting the common structural materials.

Many minor changes in steel specifications were reported and adopted, but certain proposed new tolerances for overweight of large plates were withdrawn. The most important single item in this field was a new specification for steel castings for railroad use, providing for two grades of material, with yield point from 29,250 to 36,000 lb. per square inch and elongation from 22 to 24 per cent. Improvement in the quality of wrought iron and malleable castings was registered by the adoption of higher test figures for these two materials, the tensile strength of malleable castings being raised from 45,000 to 50,000 lb. per square inch. Progress was made toward the adoption of specifications for cast-iron car wheels, following the sharp discussion of the subject a year ago, by the adoption of a tentative specification. A specification for semi-steel (to be called high-test gray iron) was also adopted, as was also an ordering form for foundry pig iron, the latter in the face of decided protest by steel-foundry and malleable men. Brass and bronze was a field of active work by the committee on non-ferrous metals, as usual; among the new specifications are two for brass and copper pipe. The fireproofing committee added a standard fire test for columns to its previous standards, and the committees on lime, gypsum, roads, timber and waterproofing all added to their routine standards. The committee on clay and concrete sewer pipe made some minor changes in the specifications for these materials.

The coal committee reported that it is impossible to prepare standard specifications for steam coal, but that sizes may perhaps be standardized. The rubber committee presented specifications for pump valves, revised its fire-hose specifications as well as others, and reported that it will shortly attempt to standardize weatherstripping, electrical protective matting, and the like. Some specifications for pigment and oils were brought out by the paint committee.

Committee Research Grows Rapidly—Research by specification committees is increasing rapidly, a number of committees now doing more research than actual standardization, particularly those in the paint and oil fields. Two interesting undertakings in this field are an exposure-test study of ship's-bottom (anti-fouling) paint, and tests of brush and spray painting.

A large number of test panels of steel, painted with many different combinations of anti-corrosive and anti-fouling paint, were placed in sea water at Perth Amboy, N. J., and Charleston, S. C., last fall, with the general result of showing that copper compounds are best in the northern water while mercury compounds are best in southern waters. Work with these two classes of materials will continue. As a first test of spray application, four identical houses at Bridgeville, Pa., were painted with the same paint, two by brush work and two by spraying (two different types of machine). Time and cost comparisons were reported by the committee for this test and for another comparative application on interior rough plaster; for the houses, expert brush work was better, while for rough plaster the spray application was both quicker and better.

The committee on drain tile is engaged in elaborate studies of the behavior of various kinds of tile in different soils but is not ready to report. The joint committee on culverts is studying, by means of a full sized test structure at Iowa State College, the pressure of fill on pipe and culvert. Committee C-9, on concrete, has under way a number of tests looking into methods of proportioning concrete.

Corrosion of Iron and Steel—Reporting further results of the inspection of exposure-test panels of iron and steel sheets at Pittsburgh, Fort Sheridan and Annapolis, the committee on corrosion, through J. H. Gibboney (Norfolk & Western Ry.), its chairman, confirmed and strengthened the results of previous inspections to the effect that copper-bearing steel is more resistant than steel containing no copper or extremely small percentages. This conclusion applies only to atmospheric corrosion; in mine-water exposure the results appear to reverse.

Interesting discussion of the relation of self-formed protective films to corrosion developed in connection with a paper "Preliminary Notes on Corrosion," by Prof. W. D. Bancroft (Cornell Univ.). The author referred immunity from corrosion essentially to stop-

page of chemical action between iron and the medium through the formation of a surface film of products of the chemical action. He declared electromotive-force measurements valueless, since they concern only the initial chemical action. Much divergent opinion came to light in the discussion, but Prof. W. H. Walker (Mass. Inst. of Tech.) and others advocated intensive small-area researches into the author's several suggestions for study of corrosion.

Water-pipe corrosion, according to F. N. Speller (National Tube Co.), appears to have some relation to film formation; protective films are formed by reaction between the initial corrosion product and the lime and silica of the water. It has been proved possible to reduce corrosion by extracting oxygen from soft domestic waters. Along the length of a pipe through which water flows, the amount of contained oxygen decreases from the point where the water enters, and this decrease can be used as a measure of the amount of corrosion going on. James Aston (M. L. Byers Co.) distinguished several types of protective-film action, including alloy protection, as in brass, and barrier protection, as in wrought iron (due to the slag layers). H. S. Rawdon (Bureau of Standards) said that the protective value of even small admixtures of tin in brass is well known, but that in general the problem of corrosion cannot be covered simply by the film theory; pitting, electrochemical effect, and other anomalous actions are of influence.

Joint Committee Activities—Co-operative and joint committee work with other societies also has shown some increase during the past year, and is now an important element of the society's standardization efforts. Through co-operation with the American Electric Railway Association a beginning was made toward wiping out differences in copper wire specifications. Joint action with several other societies led to drawing up a proposed standard specification for steel castings for locomotive use. Work on reinforced-concrete specifications by the well-known Joint Committee is still in progress, the tentative report of the committee coming up for discussion at the meeting as noted hereinafter. A similar inter-society committee is at work on specifications for reinforced-concrete culvert pipe. Several other co-operative undertakings are in progress.

Sulphur in Rivet Steel.—The first fruits of the work of the joint committee on sulphur and phosphorus in steel were presented in a report on tests of rivet steel with varying sulphur (0.03 to 0.18 per cent). Only the test data were given, without interpretation or conclusions. There were decided variations of carbon and manganese in the range of steels, and many of the test variations seemed to correspond to these rather than to sulphur variation, a fact emphasized in discussion by J. C. Unger (Carnegie Steel Co.). The most decided changes in mechanical properties appeared in the results of notched-bar impact tests, but according to special micrographic studies reported in discussion by H. S. Rawdon (Bureau of Standards), some of these may be chargeable to peculiarities of the heat treatment, especially the low impact strength found in the annealed rivet bars.

Symposium on Impact Testing—In recognition of the growing interest in testing for brittleness, a symposium on impact testing had been arranged by the society. It brought out nine important papers. Practically throughout they dealt only with the various impact-testing machines and forms of specimen, and did not discuss the meaning of brittleness or its manifestations in service or in the laboratory.

General reviews of the subject were presented by H. L. Whittemore (Bureau of Standards), who compiled a bibliography of the subject, and T. D. Lynch (Westinghouse Elec. & Mfg. Co.), who reviewed the work in impact testing done by the British Engineering Standards Association. C. L. Warwick, secretary, summarized the results of an inquiry directed to a large number of American laboratories as to their practice in notched-bar impact tests, which indicated that both the Charpy and the Izod machines are extensively used. Variation in detail, however, suggested a need for trying to standardize impact testing in this country, a recommendation in which a number of the other speakers agreed.

D. J. McAdam, Jr. (Naval Experiment Station), dealing with "Impact Tests of Metals," described the several machines, and discussed the various studies made of the relation between impact resilience and static-test resilience, with the conclusion that there is "no good reason to assume that static-resilience tests on notched bars are inferior to impact-resilience tests as a means of detecting brittleness." He further discussed desirable elements of the impact-test specimen, and analyzed the relation of form of specimen to the display of plasticity in the tests in a very interesting manner, with the conclusion that a properly notched specimen is sensitive in the third degree to variations in plasticity. T. R. C. Wilson (Forest Products Laboratory) outlined the practice of the Forest Service in impact tests of wood, chiefly the use of the Hatt repeated-blow impact machine. The relation of the height of drop at fracture in this machine to the energy of rupture obtained in a single-blow test has been found to be constant but not linear. The author concludes that static bending, single-drop impact bending and repeated-drop impact bending (all without notching the specimen) gives measures of toughness, though their results are not directly proportional. He brought out the importance, in testing wood for toughness, of allowing the deformation to spread over as much of the test specimen as it will, since it is by such study that the toughness of hickory, for example, manifests itself. The Izod test and other notched-bar tests are therefore valueless for wood.

A very different field of testing was covered by E. B. Smith (Bureau of Public Roads) under the title "Impact Tests of Road Materials." The Page impact machine for toughness of rock, the new Jackson gravel test, and impact tests for the toughness of bituminous materials were described, in addition to the slab impact tests carried on at the Arlington farm of the Bureau. The paper emphasized the absence of accepted standards in this field.

Two papers dealing with impact pressure were presented by C. E. Margerum (U. S. Navy) and A. Elmendorf (Haskelite Mfg. Corp.) under the titles "The Measurement of Pressures Caused by Impact," and "Measuring Forces in Impact." The first paper proceeded on the view that energy of rupture has no meaning and that the pressures exerted in impact should be determined; and the author, believing that it is impracticable to compute such pressures from the space-time curve of the impact, proposes the use of a crusher piece

to measure the pressure. Instead of using a crushing cylinder as in large guns, a small steel ball which bears against a piece of steel is suggested, and its application to a Charpy pendulum is shown. Mr. Elmendorf, however, showed how the double differentiation of the space-time curve to obtain impact pressure is possible, by the use of a differentiating instrument which he has devised. In this machine the tangent to the original curve is determined by the setting of an arm carrying a mirror, which mirror must be so set that the curve and its image will not form a cusp.

A distinctly new idea in tensile impact testing was brought forward by Prof. H. F. Moore (Univ. of Illinois), who described a machine in which the test specimen is hung from a steel calibration bar whose stretch is measured by a sensitive autographic extensometer; this machine has been used in some special testing of metal for toughness.

Noteworthy comments on the relation or rather lack of relation between impact and static-test results were presented under the title of "Significance of the Impact Test" by F. C. Langenberg and N. Richardson (Watertown Arsenal). Numerous test results on ordnance forgings show that when the static-test values are low the Charpy values will also be low, but good static results do not assure a good Charpy result. In the belief of the authors the impact test can be used only for comparative purposes, to determine whether a piece of material is as tough as a known standard piece. Thus, in certain work a Charpy value of 6 ft.-lb. has been known by experience to correspond to satisfactory durability of the piece; accordingly no other piece of the same kind is accepted unless it gives a Charpy test of 6 ft.-lb. or over.

In discussion, Prof. W. K. Hatt (National Research Council) described the development of his tensile-impact machine in 1898. Some anomalies in drop tests of railway axles were reported by L. H. Fry (Standard Steel Works). Mr. McAdam raised the question of whether the relation between the static and impact elastic limit had been determined, but no answer was forthcoming. A. T. Goldbeck (Bureau of Public Roads) described a pressure-measuring device of Swedish origin, in which the mark made by a ball on a blackened plane surface is measured.

Fatigue of Material—Though presented much less ambitiously—in a single paper instead of a symposium—the subject of fatigue brought out more active discussion than did impact. Profs. H. F. Moore and T. M. Jasper (University of Illinois) and J. B. Kommers (Univ. of Wisconsin) set forth in their paper the main results of fatigue investigations to date—all the final results being due to the National Research Council investigation carried on at Illinois. Various testing machines designed for the work were described, but all useful work hitherto has been done on a rotating-beam machine. Three facts of outstanding importance have been discovered: (1) Steels have an "endurance limit," a stress below which they can bear repeated stressing and reversal indefinitely—i.e., well over a hundred million reversals—and above which they fail after a limited number of reversals; the curve of stress against number of reversals, plotted on double logarithmic paper, consists of two straight lines, an inclined part and a horizontal part, the latter marking the endurance limit. (2) The endurance limit is very closely the same as the stress intensity of cyclic bending which shows a rapid increase in heat generation in the specimen, measurable after one minute or less of testing. (3) The endurance limits of different steels are fairly well proportional to their ultimate tensile strengths. While the same facts have not yet been demonstrated for reversals of direct stress (axial tension and compression), they place the subject of fatigue on a solid foundation.

D. J. McAdam in discussion reported tests made at the Naval Experiment Station on cyclic bending with specimens having uniform stress on 1½ in. length, using various steels variously tempered, including nickel steel. No abrupt break in the curve was found, but the failure stress continued to decrease slightly with increase of number of cycles. The slope of the curve increased with the hardness of the steel. L. B. Tuckerman (Bureau of Standards) showed that the Illinois results when plotted with log-log abscissas so as to emphasize the transition between the two parts of the curve exhibited a sharp break at the endurance limit quite unmistakably. He also pointed out that they are the first extensive tests carried as high as 100,000,000 repetitions, and attempted to draw a parallel with certain observations of Dalby on hysteresis loops, while decreased and finally disappeared upon continued repetition of stress, unless the range of stress was made too great, when they did not decrease.

Beautiful photographic demonstrations of stress lines in celluloid bars, shown by polarized light, were exhibited by A. L. Kimball (General Electric Co.), though unfortunately the results have not yet been correlated with the fatigue experiments. Prof. A. Marston (Iowa State College) reviewed the origin and early development of the polarized-light method, referring it back to 1870; he worked on stresses in bridge rollers by this method in 1892, and was able to develop an exact theory of the stresses in rollers.

Fatigue tests on aluminum alloys by R. L. Templin (Aluminum Co. of America) indicated a continued down-slope of the failure-stress curve; after an arrest producing a short horizontal segment there was a renewed down-slope. Some thermal tests on very hard steels were reported by H. Styri (S. K. F. Laboratories), who varied the method by carrying the repetition of stress to constant temperature: the plot of temperature rise on stress showed no sharp break as in the Illinois tests but curved continuously, going up very sharply toward the end. Thos. H. Wiggin stated that fatigue tests on chain iron gave the contradictory result that worthless material, high in phosphorus, gave good fatigue results, standing 15 million reversals at 40,000 lb. stress without failure, while good chain iron broke at 500,000 reversals of the same stress.

At another session H. F. Clemmer (Illinois Highway Department) presented a paper on some fatigue tests of concrete he has been carrying on. The test specimens were devised to simulate the conditions at the edge of a concrete road, where service observations show failure to be common. The test pieces were disposed as the radii of a circle, the circumference of which was a track over which traveled two rubber tired automobile wheels with the axle centered on the center of the circle. The radial specimens were fixed at the center and extended into the path of travel so that they were subjected to a recurring cantilever load every time the wheel passed over them. The tentative conclusions

of the test are that concrete will fail under a repetitive test that imposes a rupture modulus only 60 per cent of the static modulus, that a repetitive load producing stress below rupture will slightly increase the static strength, that the richer the concrete the better able it is to withstand repetitive loading. In the tests reported the repetitions of loads in the failure tests were comparatively low in number.

Concrete—The field of concrete was somewhat less active than usual, with no new standards and only four papers. Three committees, on Concrete, on Cement and on Reinforced Concrete, reported and in two other committees, on Lime and on Brick, matters relating to concrete were discussed. Finally the society's representatives on the Joint Committee on Concrete and Reinforced Concrete reported progress and the tentative report of that committee was discussed by the other committees interested in it.

The cement committee reported that although the standard specification for portland cement had accepted as "American Standard Specification No. 1" by the American Engineering Standards Committee it is planned to continue research work into the quality of cement and the method of testing it. The committee feels, however, that the present knowledge is not great enough to warrant standardizing the tentative compressive test for cement mortar adopted in 1916.

The completed work for the year of the committee on reinforced concrete consisted in the presentation of some proposed tentative rules for the inspection of concrete and reinforced concrete. These had been widely circulated among those qualified to discuss them prior to their printing but there was little comment upon them from the floor. In answer to some criticism that the rules seemed to be unduly rigid, Richard L. Humphrey, chairman of the committee, stated that they were intended to require a better grade of inspector that is now common in the hope of thereby raising the quality of concrete commonly placed. The rules were adopted as tentative and ordered printed in the proceedings.

The committee on concrete and concrete aggregates proposed a new tentative method of decantation tests for fine aggregate and recommended that the tentative standards on tests for voids, for organic impurities and for sieve analysis be advanced to standard. All were adopted by the meeting. Some undigested tests on concrete proportioning were presented in tabular form and the committee's criticisms of the Joint Committee's specification submitted. These latter are outlined in the succeeding paragraph.

Joint Committee on Concrete—According to the procedure of the society criticisms of the Joint Committee's tentative concrete specification, prepared a year ago, were made the duty of the respective committees of the society which are interested in the subject. Four of these committees made such criticisms, which have been submitted in detail to the Joint Committee and were outlined only at the meeting. There was no general discussion of the Joint Committee report. The chairman of the committee, Richard L. Humphrey, stated that in the fall the committee will begin its final draft of the specification, and that meanwhile it is hoped to initiate a series of field tests which will be of material assistance in formulating some of the disputed provisions of the specification.

Of the criticisms the most important is that of both Committees C-2 and C-9 which recommends that in the much discussed strength specification (Section 28 of the specifications) a tolerance be allowed according to the following provision—"At least 75 per cent of the test specimens shall show a strength greater than 80 per cent of the specified requirements in any given class." In this connection Committee C-9 says that it "favors the principle of giving the contractor an opportunity to furnish concrete of required strength according to his own methods, but the section as written allows him no latitude. Realizing the variable results which must be anticipated from tests of concrete made in the field, the committee has endeavored to recognize the rights of the contractor and to specify definitely what will be expected of him under this second method of proportioning." This committee also recommends the permission to use slag aggregate and that the mixing time be cut from 1½ to 1 min.

Committee C-7 on Lime argued for the inclusion of integral admixtures, which are prohibited in the proposed specification; Committee D-4 on Roads proposed that the words "portland cement" be inserted in front of the word "concrete" wherever it appears in the specifications and Committee C-1 on Cement argued against this suggestion. The road committee even went so far as to propose that the term "reinforced concrete" should be "reinforced portland cement concrete." Committee C-2 on Concrete stated that it considered it inadvisable to have more than one specification for reinforcing bars, but was willing to await the action of the bar committee which is now organizing.

Lime—The committee on lime submitted eight new tentative standards, mostly relating to chemical uses and laboratory practice and slightly revised the tentative standards for quicklime and hydrated lime. All were adopted without comment. As appendices to its report the committee submitted the results of several laboratory investigations into the effect of hydrated lime on concrete and a study of the tests on that subject made in the last two years by Prof. Duff A. Abrams. Tests made by W. E. Emley (Bureau of Standards) show that the addition of lime to a water-constant concrete decreases flow and increases strength while the addition of water to a lime-constant concrete does just the opposite. When both lime and water are added it is therefore difficult to evaluate results. Practically the same deductions were made by H. C. Berry (University of Pennsylvania) from some tests which have not yet been completely digested. H. F. Clemmer (Illinois Highway Department) found that with fine-sand concrete up to 7½ per cent, hydrated lime showed a slightly smaller strength but with coarse sand there was a slight increase. There are no definite results as yet from the tests on the stabilizing effect of lime on moisture content of concrete.

T. B. Shertzer (Lime Association) presented in abstract an elaborate study of the Abrams' tests on hydrated lime in concrete. In general he stated that lime can absorb an optimum amount of water; any additional amount merely goes to dilute the concrete. He claimed that in the Abrams tests relatively too much water was used in the lime-admixed concrete and that the loss of strength shown was due to this and not to the lime. He criticized the method of determining the water content by multiplying the base amount rather than by adding to that amount and said that if the

mixtures are adjusted so as to study those of proper water content the average compressive strength of concrete with hydrated lime was 9 lb. per square inch greater than that without lime. There was no comment on Mr. Shertzer's discussion.

Concrete Brick—In the reprinted report of the committee on brick there were a summary of tests on concrete brick made at Columbia University and a Proposed Tentative Specification for Concrete Building Brick. When the report of the committee was submitted it was stated that by a vote of 12 to 10 the committee had decided to withdraw the concrete brick specification because of inadequate data. The reported tests showed that "the limit of 1,500 lb. per square inch specified for the strength of individual concrete bricks is equivalent to approximately 3,800 lb. per square inch for individual clay bricks and both give when laid in 1:3 portland cement mortar, masonry of about 1,000 lb. per square inch compressive strength." Most of the producers in the committee are from the clay brick field. The standard sizes of paving brick adopted at the recent conference at Washington were approved by the committee and the sizes included in the standard specification of the society, subject to letter ballot.

New Test Methods—Several of the papers presented described new instruments or test methods.

Measuring the thickness of galvanized coatings can be done very much more simply than heretofore possible by a new method described by D. M. Strickland (American Rolling Mill Co.). A sample of known area is placed in a known amount of acid and the temperature rise measured after 30 sec.; the rise multiplied by a constant gives the weight of coating in ounces per square foot. The method is quick and accurate and can be used in the field.

Two methods by which the quality of welded joints can be measured were tried out by the Westinghouse Electric & Manufacturing Co., results being reported by T. Spooner and I. F. Kinnard. They depend on measuring the magnetic and the electric conductivity respectively. Both gave a close check on tensile tests, and, while tending to average local defects, gave positive indication of poor welds. The magnetic method was found the more readily applicable of the two.

Some new devices for the study of paints were brought out. One is a centrifugal plate for forming paint films whose characteristics and defects are to be studied; this was developed at the Bureau of Standards and was described by P. H. Walker and J. G. Thompson. The other is an accelerated-test arrangement for outside paints, which consists of a barrel in which the specimens are exposed to strong ultra-violet light, either with or without water spray. It is claimed to affect the paint as much in one day as sunlight does in one month. Discussion of this paper, however, threw strong doubt on the value of the method as a test of paint durability.

F. H. Jackson (Bureau of Public Roads) proposed an impact test for gravel, comprising a falling steel ball which strikes the test specimen of gravel held on a lower steel ball. The measure of the test is the height of fall required to shatter the gravel. It is offered as a method of testing gravel aggregate for concrete in substitution for abrasion tests, which apparently do not give a true measure of the availability of the concrete for road use. This test should reject soft material when properly applied. It was stated that the New Hampshire Highway Department had tried the test on some local gravels, mainly of metamorphic origin, and that it seemed to detect poor specimens that might have passed the Deval test of wear. It was felt that it could be adapted to discover those specimens which had an outside sufficiently hard to withstand ordinary wear tests but a rotted interior, and if so it would be a useful method. R. W. Crum (Iowa Highway Department) said that the test would fall down on the smaller particles, which often are troublesome.

The committee on methods of testing submitted the preliminary steps in a nortworthy study of the various tests applied to materials. Classification of methods according to type of test has been made with a view to co-ordination of tests of similar nature and the adaptation of the best details from one test to another. The committee also presented some suggested definitions relating to testing, which were stated by H. F. Moore to be frankly an expression of the engineering rather than the physicist viewpoint. Some of the terms, principally "unit stress" instead of "stress intensity" were severely criticized by L. B. Tuckerman (Bureau of Standards)

Other Papers of Engineering Interest.—H. S. Rawdon and S. Epstein (Bureau of Standards) in a paper on the nick-and-bend test for wrought iron showed that fracture appearance (fibrous or crystalline) is chargeable to the manner of breaking the bar rather than to the quality of the iron. Some observations by Robert Job confirmed this. Tests of steel castings reported by L. H. Fry (Standard Steel Works) indicated that castings may not have a definite elastic limit but often give convex or irregular stress-strain curves, so that the elastic limit should not be specified. Other tests disagreed with both the facts and the conclusions reported.

An elaborate series of measurements of Brinell ball impressions in various metals was reported by Profs. F. E. Foss and R. C. Brumfield (Cooper Union), whose main result was to show that calculations of hardness number from depth of impression are likely to be seriously in error inthe case of very hard steels.

Important papers on subgrade materials in roads by J. R. Boyd (U. S. Bureau of Roads), on pit-run gravel in concrete by L. W. Crum (Iowa Highway Department) and on concrete proportioning by F. E. Richart and E. E. Bauer (University of Illinois) will be abstracted in later issues.

New Officers—Dr. George K. Burgess, of the Bureau of Standards, was elected president, succeeding Charles D. Young of the Pennsylvania R.R. Prof. Wm. H. Walker, of Masachusetts Institute of Technology, was elected vice president, and D. M. Buck, W. M. Corse, W. K. Hatt and J. R. Onderdonk were elected members of the executive committee.

The presidential address of Mr. Young commemorated the fact that the meeting was the 25th since the society's foundation in 1898 by a scholarly review of the work undertaken and accomplished in that period. Some brief inaugural remarks by the new president proposed that the society now undertake to make its standards more generally applicable, and suggested that such agencies as the Federal Specification Board would be glad to have their work taken over by the society.

The attendance was the greatest in the history of the society, being 743 men and 172 ladies. The previous record was 866 total in 1919.

LETTERS TO THE EDITOR

This department aims to be a forum for the discussion of the views of engineers and contractors. The range of interest should be as wide as possible. Contributors are, therefore, asked to make their letters short.

Rivet-Hole Deductions in Tension Members

Sir—Several formulas and rules for calculating net sections of riveted tension members have been proposed, as mentioned in your issue of June 1, p. 911, in connection with a brief abstract of Prof. C. R. Young's paper in Bulletin No. 2 of the University of Toronto.

The exact theory may be applied by the use of diagrams, but since the deduction increases with increasing size of rivet several diagrams must be employed to cover all sizes of rivets, or else a single diagram for 1-in. holes may be used by entering the diagram with s/h and g/h instead of s and g. It is not always convenient to use such diagrams, and on this account approximate rules have been proposed in lieu of the exact theory. Prof. Young suggests the formula:

$$x = 1.50 - 1.25\ s/g,$$

and D. B. Steinman, in *Proceedings* of the American Society of Civil Engineers for April, proposes the formula:

$$x = 1.30 - s/g.$$

These straight-line formulas are sufficiently accurate for practical use, but in exceptional cases they do not give good results. The writer suggests the following formula as being accurate enough in all cases and at the same time practically as convenient as the straight-line formulas if the slide-rule is used:

$$x = 1 - \frac{3}{h}\left(\frac{s}{g+3}\right)^2$$

where x = the fraction of a rivet hole to be deducted.
g = gage, or transverse spacing,
s = stagger, or longitudinal spacing, and
h = diameter of rivet hole.

Ordinarily h is taken as ¼ in. greater than the nominal diameter of the rivet, hence the coefficient $3/h = 4$ for ¾-in. rivets, 3 for ⅞-in. rivets and 2.4 for 1¼-in. rivets.

In using this formula with the slide-rule, $g + 3$ on the C-scale is set opposite s on the D-scale, and the value of the negative term of the right-hand member of the equation is read on the A-scale opposite $3/h$ on the B-scale. This result is subtracted mentally from unity, giving the value of x. The computation is made in a very brief time.

The accompanying table has been prepared to show the comparative values of x as given by the proposed formula and by the exact theory. It will be seen that the agreement is fairly close throughout a wide range of values of s, g and h.

VICTOR H. COCHRANE,
Consulting Engineer.

Tulsa, Okla., June 19.

COMPARATIVE VALUES OF RIVET-HOLE DEDUCTIONS

E, computed by theoretical formula

A, computed by approximate formula, $x = 1 - \frac{3}{h}\left(\frac{s}{g+3}\right)^2$

Value of Stagger s, in.	¾-in. Rivets (¾-in. Holes)								⅞-in. Rivets (1 in. Holes)								1¼-in. Rivets (1¼-in. Holes)							
	g=2 in.		g=4 in.		g=6 in.		g=8 in.		g=2 in.		g=4 in.		g=6 in.		g=8 in.		g=2 in.		g=4 in.		g=6 in.		g=8 in.	
	E	A	E	A	E	A	E	A	E	A	E	A	E	A	E	A	E	A	E	A	E	A	E	A
½	0.96	0.96	0.99	0.98	0.99	0.99	1.00	0.99	....	....	0.99	0.98	1.00	0.99	1.00	0.99	....	....	0.99	0.99	1.00	0.99	1.00	1.00
1	0.83	0.84	0.95	0.92	0.98	0.95	0.99	0.97	....	....	0.96	0.94	0.98	0.96	0.99	0.98	....	....	0.96	0.95	0.99	0.97	0.99	0.98
1½	0.64	0.64	0.86	0.82	0.95	0.89	0.97	0.93	....	....	0.90	0.86	0.96	0.92	0.98	0.94	....	....	0.90	0.89	0.97	0.93	0.98	0.95
2	0.24	0.36	0.73	0.67	0.89	0.80	0.94	0.87	0.40	0.52	0.79	0.76	0.91	0.85	0.95	0.90	....	....	0.81	0.80	0.92	0.88	0.95	0.92
2½	0	0	0.53	0.49	0.77	0.69	0.88	0.79	0.09	0.25	0.63	0.62	0.82	0.77	0.90	0.85	0.25	0.40	0.69	0.69	0.85	0.81	0.91	0.88
3	....	....	0.28	0.27	0.65	0.56	0.80	0.70	0	0	0.43	0.45	0.72	0.67	0.84	0.78	0	0.14	0.52	0.56	0.76	0.73	0.86	0.82
3½	....	....	0	0	0.46	0.40	0.69	0.60	....	....	0.20	0.25	0.58	0.55	0.75	0.70	....	0	0.34	0.40	0.64	0.64	0.79	0.76
4	....	....	....	....	0.24	0.21	0.56	0.47	....	....	0	0.2	0.40	0.41	0.65	0.60	....	....	0.12	0.22	0.51	0.52	0.70	0.68
4½	....	....	....	....	0	0	0.39	0.32	....	....	....	0	0.21	0.25	0.51	0.50	....	....	0	0.01	0.34	0.40	0.59	0.60
5	....	....	....	....	....	....	0.19	0.17	....	....	....	....	0	0.08	0.35	0.38	....	....	....	....	0.15	0.24	0.47	0.50
5½	....	....	....	....	....	....	0	0	....	....	....	....	....	0	0.17	0.25	....	....	....	....	0	0.10	0.32	0.40
6	....	....	....	....	....	....	....	....	....	....	....	....	....	....	0	0.10	....	....	....	....	....	0	0.16	0.28
6½	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	0	....	....	....	....	....	....	0	0.16

Concrete and Brick Wall Tests

Sir—An article in *Engineering News-Record* for May 11, p. 795, entitled "Advocates Four-Inch Brick Walls," a brief abstract of a paper read by Wm. Carver of the Common Brick Manufacturers' Association before the Building Officials' Conference, refers to certain tests on thin walls made in England. The inference which one would draw from this abstract would naturally be to the effect that the tests were confined to brick walls. No particular criticism attaches to Mr. Carver because he failed to report other data from these same tests pertaining to the strength of thin walls of concrete cast in place and of concrete block. If, however, the subject is worth presenting at all to the building industry, it appears that it would be worth while to give the tests complete rather than that pertaining to one building material only.

The tests in question were made by the British Building Materials Research Committee and published in brief in the August, 1920, issue of *Concrete and Constructional Engineering*, under the title "Stability of Thin Walls, and Heat Transmission Through Thin Walls." A glance at the test data will show some interesting comparisons between the strength of brick walls and walls of concrete cast in place or of concrete block. Thus, the very next line of the table which contains the horizontal pull required to break the 42-in. section of brick wall gives the horizontal pull necessary to break the same length of section of concrete wall (1,262 lb. for a 4½-in. concrete wall, and 962 and 1,253 lb. for 4½ in. concrete-block walls; the corresponding figures for brick walls of the same thickness laid in cement mortar ranged from 705 to 895 lb.).

While the conclusions of this committee were to the effect that any of the walls tested have sufficient crushing strength to act as partitions, it is nevertheless interesting to note the comparative strength afforded by walls of the various materials tested. Tests of this sort should be encouraged because they will undoubtedly prove that a great deal more material is ordinarily used for partitions in dwellings and apartment houses than is required. This uneconomical use of material must, of course, be laid at the door of building and code regulations which require excessive thicknesses, not only of partition walls but of exterior walls as well.

A. C. IRWIN,
Engineer, Structural Bureau,
Portland Cement Association.

Chicago, June 21.

Field Check on Earth Pressures

In the article by H. S. Schick, entitled "Field Check on Formulas for Earth Pressure" in *Engineering News-Record*, June 15, 1922, the following appeared on p. 994. "If it were assumed that the rock actually carried no horizontal load whatever it could be made to appear that the reduction amounted to 2.5 per cent, ..." This figure should have been 26.5 per cent.

NEWS OF THE WEEK

New York, July 6, 1922

Detroit Council Delays Approval of Pennsylvania R.R. Plan

The City Council of Detroit has refused to grant a hearing on the ordinance that has been prepared to permit the construction of the Detroit end of the new Pennsylvania Toledo-Detroit extension. According to news despatches, this attitude of the council is based upon dissatisfaction with the dispositions of the Père Marquette R.R. and the Wabash R.R. in the matter of grade separation in Detroit. The Pennsylvania under its new plans will share trackage rights and other joint facilities with these railroads.

Reports indicate the probability of the Council's eventually withdrawing its opposition and consenting to hearings on the ordinance.

Coal Strike Conference Meets at President's Call

Called into conference by President Harding, representatives of the bituminous coal operators and miners together with Secretaries Davis and Hoover are seeking a way out of the strike that has been in effect since April 1. At the opening session the President indicated to both parties that the national government must intervene to restore coal production unless they can adjust their differences.

News reports since the beginning of the conference foreshadow a deadlock that will probably bring about such intervention. The operators have rejected the miners' proposals for a central competitive field wage conference, and the miners will have none of the operators' plans for independent district wage conferences. Government participation in a settlement of the strike will probably be directed toward a far-reaching reorganization of the bituminous coal industry.

House Accepts Senate Amendment to Muscle Shoals Appropriation

(Washington Correspondence)

By a vote of 145 to 105 the House of Representatives on June 24 agreed to concur in the Senate amendment to the War Department appropriation bill carrying $7,500,000 for the reopening of construction work on the Wilson Dam at Muscle Shoals. The vote carried with it, however, approval of an amendment by Representative James, of Michigan, which provides that no portion of the $7,500,000 is to become available before October 1. The purpose of the amendment was to give additional time for Congress to pass definitely on the Ford offer. The amendment was actively supported by those favoring the Ford offer who saw in the Senate amendment an effort to delay definitely any action on the Ford proposition. The House voted down, however, another amendment proposing a delay until January 1 before use could be made of the appropriation provided by the Senate amendment.

The Newly Elected Secretary of the American Society of Civil Engineers

JOHN H. DUNLAP

New Rules Governing Federal-Aid Road Work to Be Issued

Washington Correspondence

Following the signing of the federal highway act by the President June 20, the U. S. Bureau of Public Roads is preparing the regulations for administering the road statutes. These regulations have been under consideration for many months. They would have been promulgated earlier but it was deemed advisable to wait until after the passage of this year's bill. The regulations now are in the hands of the solicitors of the Department of Agriculture who are determining what changes, if any, are necessary as a result of this latest legislation.

The $50,000,000 which will be available during the current fiscal year means some reduction in the amount of road work which can be done in some states. The principal objection to the new bill is the reduction in the maximum amount per mile of federal aid allowed. As the provision is becoming more clearly understood, more and more complaints are being received, particularly from states having mountainous, desert, or swamp lands, and from sections where heavy bridges are required.

Maps of the 7-per cent system have been received from practically all the states. They show that the systems connect up well at the state boundaries. This is true to an unexpected extent.

Marconi Gets Fritz Medal

The John Fritz medal for 1922 has been awarded Senator Guglielmo Marconi for his invention of wireless telegraphy. The formal award will be made today in the auditorium of the Engineering Societies building, New York City. The committee in charge of arrangements is composed of Benjamin B. Thayer, chairman; George S. Webster, Philadelphia; Walter M. McFarland, New York City, and William McClellan, Philadelphia. At the presentation ceremonies addresses will be delivered by James R. Sheffield, president of the Union League Club, and by Michael Pupin, of Columbia University.

Railroad Shopmen Walk Out in Defiance of Labor Board

Protesting against the wage cut authorized by the Railroad Labor Board, the members of the railroad shopcrafts unions walked out on July 1. Six trades are involved: machinists, boilermakers, blacksmiths, sheetmetal-workers, electrical workers, and carmen, which in lude, together with helpers and apprentices, about 401,000 men.

An effort by the Labor Board to forestall the strike was frustrated by the refusal of B. M. Jewell, president of the railway employees' department of the American Federation of Labor, to attend a conference it had called for July 1. The government has indicated its intention to back the decision of the Labor Board with its full authority and to adopt all necessary measures to keep the trains running.

Decision not to strike has been announced by the maintenance-of-way forces who also were affected by the wage cuts. Other unions have not yet announced their intentions.

Townsend Favors Distribution of Remaining War Materials

Washington Correspondence

A plan for distributing to the states through the Department of Agriculture all the remaining surplus war material which they can utilize in road building and other purposes is put forward in a resolution introduced June 26 by Senator Townsend of Michigan. In the resolution it is stated that the various departments of the government still have on hand war supplies which cost more than $1,000,000,000. Senator Townsend calls attention to the fact that this surplus is being diposed of at public auction at nominal prices and "many times re-sold by the purchasers at unconscionable prices."

The resolution specifies, however, that it is in no way to interfere with the existing law which deals with the distribution of equipment suitable for road building purposes. Under Senator Townsend's plan, requisition would be made by the Governor of each state for such material as could be used by the states.

Dr. Elliott New President of Purdue University

Dr. Edward C. Elliott, whose resignation as chancellor of the University of Montana to accept the presidency of Purdue University was noted in this journal June 1, p. 929, has had an experience of 27 years as an educator and university executive. Born in Chicago in 1874, he was graduated from the University of Nebraska in 1895 and spent the next two years at that institution as teaching fellow in chemistry prior to receiving his degree of Master of Arts in 1897. After serving four years as superintendent of schools in Leadville, Colo., he undertook graduate work in education at Columbia University, New York City, where he received his Ph.D. in 1905. Eleven years as a faculty member of the University of Wisconsin were followed by a call to become the first chancellor of the University of Montana, a position which he accepted Feb. 1, 1916. From this post he resigned May 16, 1922 to become president of Purdue University, Lafayette, Ind., where he will assume his new duties Sept. 1.

Dr. Elliott has served as educational adviser to many states and municipalities in different sections of the country and is now a member of the School Finance Inquiry Commission, which is making a nation-wide study of educational expenditures. He is the author of three books dealing with problems of public education: "Fiscal Aspects of Public Education in American Cities" (1905); "City School Supervision" (1913); "State and County School Administration" (1915, with Prof. Cubberley of Stanford University).

At the outbreak of the war Dr. Elliott was appointed a member of the Montana State Council of Defense and served as adviser to the Committee on Education and Special Training of the General Staff during 1918 and also acted as regional director of the Student Army Training Corps for the five northwestern states.

Automatic Train Control Ordered by I.C.C. for 49 Railroads

Declaring that "the art of automatically controlling trains has long since passed the experimental stages," the Interstate Commerce Commission has issued final orders to 49 of the more important railroads to install automatic train-control devices on about 5,000 miles of their lines before Jan. 1, 1925. It is estimated that the cost of equipping with one of the devices that has been tried, the way and rolling stock of a single-track railroad would be about $1,500 a mile.

Although it is contemplated that the roads will offer no further opposition to this step, it is improbable that any immediate action will be taken toward compliance with the order. Indications are that the railroads will carry on experiments on their own account to determine more accurately some of the economic factors involved.

Appoint Commission for Chicago Harbor Project

An interstate commission to investigate the feasibility of the project for a new lake-front port in the Chicago district to be known as Illiana, as the Illinois-Indiana state line, has been appointed under joint acts of the two state legislatures. The chairman is Walter J. Riley, president of the O. F. Jordan Co., East Chicago, Ind. Col. C. McD. Townsend, U. S. A., represents the United States on the commission. Mr. Riley and E. R. Erskine, president of the Studebaker Corp., South Bend, Ind., represent Indiana; and Illinois is represented by C. R. Miller, state director of public works, and W. L. Sackett, state superintendent of waterways, Springfield, Ill. The Illiana harbor project originated largely with Col. W. V. Judson, U. S. A., and was described in Engineering News-Record of Jan. 20, 1921, page 120, and July 28, 1921, pages 120 and 166.

The Engineer in Public Life

H. M. HUNTINGTON

The Board of Equalization and Public Service Commission is one of the departments recently created by the state legislature of Wyoming. This board has to do with tax rates, such rates as are established by large corporations, and many other commercial and economic problems. Wyoming has selected an engineer on this board, H. M. Huntington, who was appointed when the board was organized. Mr. Huntington began his engineering career with the Chicago, Burlington & Quincy R.R. 32 years ago. He has been in continuous practice ever since, his experience including service with the U. S. Geological Survey and the U. S. General Land Office. He was county engineer of Sheridan County, Wyoming, for three terms, city engineer of Sheridan and chief and consulting engineer for the Sheridan waterworks.

Some years ago Mr. Huntington studied law but discontinued it just before taking his final examinations to be admitted to the bar. He was elected to the Tenth Legislature of Wyoming where he exerted much influence in matters pertaining to irrigation and engineering in general.

Mr. Huntington was born at Niles, Mich., in 1869. He went to Wyoming forty years ago. He resigned his position as city engineer of Sheridan to accept his present position on the State Board of Equalization in 1919 and was reappointed in 1921 for a six-year term.

Ketchum Named Engineering Dean at University of Illinois

Prof. Milo S. Ketchum, head of the department of civil engineering at the University of Pennsylvania since 1919, has been appointed dean of the college of engineering, University of Illinois, where he will assume his new duties Sept. 1. Prof. Ketchum is 50 years old and has had a wide experience both as an educator and a consulting engineer since his graduation from Illinois in 1895. He served as dean of the college of engineering at the University of Colorado for a number of years and was in charge, during the war, of the construction of important explosive plants at Nitro, W. Va. In 1903-04 he held the position of contract manager with the American Bridge Co., in charge of the Kansas City, Mo., office. His professional work includes a wide variety of engagements on structural and irrigation problems and he is well-known as the author of a number of books dealing with the design of steel mill buildings, highway bridges, grain elevators and mine structures.

An extended biographical sketch of Prof. Ketchum appeared in *Engineering News- Record* of Sept. 25, 1919, p. 632, at the time of his appointment to the University of Pennsylvania.

Urge $74,000,000 Bond Issue for St. Louis Public Works

The General Council on Civic Needs of St. Louis, Mo., made up of 208 representatives of 70 civic organizations, has announced its recommendations as to items to be included in a proposal for a bond issue for municipal improvements to be presented for vote during the coming autumn. A feature of the report is the statement that the support of the council is contingent on the appointment of a representative bond supervisory committee to co-operate with the municipal authorities in the prosecution of the work.

The items enumerated by the council are:

Hospitals, institutions, health	$5,000,000
Complete sewer and sanitation program	20,000,000
Neighborhood playgrounds and recreation	4,000,000
Complete major street plan	17,250,000
Paving existing thoroughfares	2,800,000
Grade crossing elimination and viaducts	1,600,000
Municipal heating, lighting and mechanical plant	1,000,000
Fire Department equipment	400,000
Civic building	4,000,000
City markets	1,250,000
Memorial plaza and sites for memorial and civic buildings	5,000,000
	$62,300,000
Water works	*12,000,000
Total	$74,300,000

* Waterworks projects are financed independently of other municipal institutions.

Harding Signs New York Port Bill

President Harding has signed the bill approving the plans for the development of the port of New York as adopted by the New York Port Authority, a board operating under the joint auspices of the states of New York and New Jersey.

Study Truck Transport

A study of bus and truck transportation on federal-aid highways is being made by the U. S. Bureau of Public Roads. The work is under the immediate direction of Major I. C. Moller, who has established temporary headquarters at Boston so as to gather data as to this situation in New England. Questionnaires are being sent out with the idea of obtaining full information as to the distance covered by these operations.

Paris-Orleans Ry. To Electrify Line from Paris to Vierzon

According to recent dispatches, the Paris-Orleans Ry., one of the six great systems of France, has placed an $8,000,000 contract for 80 freight locomotives and 80 heavy high-speed passenger motor-cars. This equipment will be furnished by a group of French manufacturers headed by the Compagnie Française Thomson-Houston, representatives in France for the International General Electric Co. Although the larger part of the order will be manufactured in France, considerable quantities of material of American manufacture will, it is understood, also be required.

The engines will be used on an extension of the original electricification made a quarter of a century ago. The motor-cars will replace and extend the present suburban steam service out of Paris.

After a study of European and American experience the P-O Ry. has adopted a program for electrification based on the 1,500-volt, d.c. system. The first part of the new 1,500-volt section will cover 125 miles of dense main-line traffic between Paris and Vierzon. The high speed through passenger service from Paris to Vierzon on the way to southern France will be served by 1,500-volt d.c. locomotives weighing 250,000 lb. each and capable of running regular speeds between 80 and 85 m.p.h.. Although these machines are not included in the contracts thus far awarded, the railway company is expected to announce the placing of this business at an early date, and to give consideration to the purchase of large numbers of additional locomotives for use on the 2,000 miles of its system in the central plateau region.

Louisville Seeks Power Permit

The city of Louisville, Ky., has applied to the Federal Power Commission for a preliminary permit covering a power development at the United States dam in the Ohio River at the Falls of Louisville. The dam and the lock at that point have been recommended for reconstruction. Primary power to the extent of 28,000 hp. would be available at that point, it is estimated. The city plans, however, to install equipment capable of generating 50,000 hp.

Record June Rainfall at New York

June rainfall at New York City totalled 7.86 in., compared with 7.70 for June, 1887, the highest previous record for 51 years since the local office of the United States Weather Bureau was established.

Suspension Bridge Proposed for San Francisco Bay District

At a recent hearing before a board of army engineers in San Francisco a proposal was made to cross the bay at Carquinez Straits with a 3,000-ft. suspension bridge with a 1,500-ft. central span. It is understood that the bridge, if constructed, would be used by a local transit company.

N. P. Lewis Working on City Plan Program for Boston

As consultant to the City Planning Board of Boston, Nelson P. Lewis, consulting engineer, New York City, is making a brief study of existing conditions and available data for the purpose of suggesting a program of work to be carried out to reach the results desired. He will also suggest what use could profitably be made of existing agencies and what work could best be carried out under the immediate direction of the board.

Bids Asked for New Aqueduct for District of Columbia

With $2,950,000 made available in the District of Columbia appropriation bill to be applied on the construction of a concrete conduit from Great Falls on the Potomac to Washington, the District engineer has advertised for bids, to be opened July 17, for the construction of that portion of the conduit between Great Falls and the District line. The entire project includes also additional filters, a pumping station, and two reservoirs.

Organize $1,000,000 Firm To Handle Ohio River Traffic

Formation of the Inland Waterways Co., capitalized at $1,000,000 to build an extensive system of docks on the Ohio river at Louisville, Ky., and Jeffersonville, Ind., and the lease to the company of the necessary waterfront lands by the city of Louisville has been announced.

The docks at Louisville and Jeffersonville, on which work will be begun this summer are expected to open up possibilities of freight transportation on the Ohio river which hitherto have been impracticable, lacking an actual connection between the river barges, the railroads and the traction systems. The Interstate Public Service Co. which operates and connects with an extensive system of electric railway lines will construct the docking system on the Indiana side of the river and will conduct operations there. This company has held options for some time on a great deal of the Ohio river front at Jeffersonville. The new docks on the Kentucky and Indiana side will have direct connection with both railroad and traction lines.

The Inland company plans to float much heavy freight down the Ohio river from Pittsburgh, and to extend its operations down the river from Louisville as soon as the government locks are completed. In this way practically all-year operation will be assured.

The directors of the new company are James P. Barnes of the Louisville Ry. Co., D. B. G. Rose, Patrick Calhoun, Jr., Churchill Humphrey, Sevier Bonnie, James C. Willson, and Harry Reid.

A. S. Baldwin

Archibald Stuart Baldwin, for several years chief engineer of the Illinois Central R.R. and later vice-president of that road, died suddenly on June 27 while on a train from New York to Chicago. Mr. Baldwin was born at Winchester, Va., Sept. 28, 1861, and was educated at the Shenandoah Valley Academy, Winchester, and Staunton Military Academy, Staunton, Va.

He began his railway career in 1879 as an axeman on the Richmond & Allegheny R.R. (now part of the Chesapeake & Ohio Ry.) but later went to the Iron & Steel Works Association of Virginia as assistant engineer and then chief engineer. He returned to railway work in 1882 as assistant engineer on the Philadelphia extension of the Baltimore & Ohio R.R. and in 1885-1886 was principal assistant engineer on the Chicago, Milwaukee & St. Paul Ry. bridge over the Missouri at Kansas City. In 1887 he became an assistant engineer on the Louisville & Nashville R.R., where he remained until 1907, when he was appointed principal assistant engineer of of the Illinois Central R.R. In a short time he was made engineer of construction and in 1905 became chief engineer.

This position Mr. Baldwin retained until 1918 when he was promoted to be a vice-president of the Illinois Central R.R. Co., and in 1920 he was appointed vice-president in charge of the Chicago terminal improvement and valuation. In this last position he had supervision over two exceptionally important engineering projects: (1) Revision of the complicated passenger and freight terminal facilities; (2) electrification of suburban service and ultimately of main line and switching service also. He had attended the International Railway Congress at Rome in April and afterwards spent some time investigating European practice in railway electrification.

Mr. Baldwin was notable for his engineering skill, his executive ability and his pleasing and courteous personality. He was a member of the American Society of Civil Engineers and past president of the American Railway Engineering Association (1917) and the Western Society of Engineers (1919). An appreciative biography of Mr. Baldwin by the late Isham Randolph appeared in *Engineering News* of Feb. 17, 1917, p. 271.

Am. Soc. C. E. Directors Established Quarterly Meetings

In the editorial in *Engineering News-Record*, June 29, p. 1063, it is stated that the new constitution of the American Society of Civil Engineers prescribes the quarterly meetings of the society. This is not correct. The new constitution makes no provision as to meetings of the society different from the old constitution. The addition of spring and fall society meetings was approved by the Board of Direction at its meeting last January.

William Cushing Edes

William Cushing Edes, former chairman of the Alaskan Engineering Commission, whose death on May 25 was noted in *Engineering News-Record*, June 8, p. 975, was one of the best known and most successful railroad location engineers in the West, having devoted a long and active lifetime to this branch of engineering. He was born at Bolton, Mass., in 1856; graduated from Massachusetts Institute of Technology with the class of 1876 and after practising his profession in Massachusetts for a few years went to California in the late seventies. Entering the employ of the Southern Pacific R. R. he was identified with the location and construction of many of the main and branch lines built by that company. Among other work he was associated with William Hood, chief engineer of the Southern Pacific, in the location of that company's main line through Arizona, New Mexico and Texas. Later he had charge of location of parts of the Southern Pacific's coast route, relocation of the main line in Nevada and the location of difficult sections of the Central Pacific route over the Sierra Nevada Mountains.

Located Difficult Route

For four years he was associated with W. B. Storey as assistant chief engineer of San Francisco and San Joaquin Valley R. R. between Richmond and Bakersfield, now a divison of the Santa Fe system. When the Southern Pacific and the Santa Fe decided to join in the construction of a single line that would tap the rich timber country along the northern California coast, the combination came about primarily because of the expense of building a suitable line for more than 100 miles in the canyon of the Eel River. This route is said to have been one of the most difficult pieces of railroad building ever undertaken in this country. Mr. Edes was selected to locate the joint route; his location was adopted and construction was carried out under his supervision. Mr. Edes was chief engineer of this system which connects Eureka with San Francisco from 1907 to 1914.

In May of 1914 he was selected by President Wilson as chairman of the Alaskan Engineering Commission. He established headquarters at Anchorage, Alaska, and after considering three routes for the railroad to the interior selected the one that he believed to be the most practical at a preliminary cost of slightly over half the amount appropriated for that work. Subsequent to the location phase of the Alaskan work he divided his time between Alaska and Washington, his presence being required by various Senate committees. When the other two members of the commission resigned, one to become Governor of Alaska and the other to enlist in the World War, Mr. Edes was in full charge of and responsible for all the activities of the Alaskan project. After five years of service on the commission and with the project well along toward completion, he resigned in December, 1919, to take a much needed rest. From that time until his death he made his home in California, devoting his attention from time to time to railroad engineering problems on which he was called into consultation.

Progress on Coastal Plain Bridge

Progress on the construction of the Santee River (South Carolina) bridge which, when completed, will be one of the longest county bridges in the South, is indicated in the accompanying view. The project is part of a recently-inaugurated and long-needed development for bridging the swamp lands of

BRIDGE AND FILL CROSSING SANTEE RIVER

the Coastal Plain. The Santee River bridge is a joint undertaking of Williamsburg, Berkeley and Charleston Counties. The Rollin Construction Corp., New York City, is doing the work at a cost of about $800,000. Design features of the bridge and incidental construction were described in *Engineering News-Record*, Nov. 3, 1921, p. 725.

Study Bridge Fire Protection

The U. S. Bureau of Public Roads announces that a committee composed of a representative of the bureau, and representatives of the National Board of Fire Underwriters, lumber and creosote industries, and *Engineering News-Record* is investigating the subject of the destruction of steel bridges by fire and the best means of protection. This is in line with the campaign to prevent fires caused by the careless throwing of cigars or cigarettes when lighted while crossing a bridge with a wooden floor. Many such fires are started in this way the lineman says, but most of them are put out with small damage. Heat from a burning floor sometimes causes the destruction of the whole bridge by softening the metal near it, and the breaking of one weakened part will cause the whole span to drop into the river. On some large bridges a watchman is kept to guard against this danger and in a dry season fires have been known to occur almost daily. Announcement of the formation of the investigating committee was made in *Engineering News-Record* of Dec. 29, p. 1078. The work is nearing completion.

Construction Council Board Meets

In conformity with the resolution passed at the organizing meeting of the American Construction Council in Washington last week, the Board of Governors (which is the new name adopted for the council's executive board) met at the home of the president, Franklin D. Roosevelt, in New York, on June 23. Plans for the council's initial work were discussed, four lines of action determined upon, and an executive committee, composed of one representative from each of the eleven groups in the council, was appointed.

The work to be undertaken immediately concerns the lessening of unemployment in the industry and the lengthening of the construction season; the promotion of the establishment of apprenticeship systems for building mechanics; the formulation of a code of ethics and of standards of procedure covering all branches of the industry, and a study having in view the determination of the best way of collecting statistics gathered by the various associations and societies.

The executive committee, which is to function between the meetings of the Board of Governors, is as follows:

Architects, D. Knickerbacker Boyd, Philadelphia; engineers, Charles F. Loweth, Chicago; general contractors, Noble Foster Hoggson, New York; subcontractors, Oscar A. Reum, Chicago; construction labor, John Donlin, Washington; material and equipment manufacturers, William M. Ritter, Columbus; material and equipment dealers, M. T. Bannigan, Utica; bankers, bond and insurance interests, Willis H. Booth, New York; railroad and public utilities, Francis Blossom, New York; federal state, county and municipal officials, J. M. Gries, Washington; builders exchanges and building trades employers associations, Walter Klie, Cleveland.

Lower Postage for Publications Proposed in Bill

Reduction of second-class postage rates, originally imposed as war taxes, is provided for in a bill introduced in the House of Representatives June 9 by M. Clyde Kelly, of Pennsylvania. The proposed measure retains the zone system and even with the reductions gives the government 175 per cent more than the pre-war rates. The present postage rates on *Engineering News-Record* and other publications are 325 per cent higher than the rates before the war. Hearings on the measure will soon be held.

"The newspapers," said Mr. Kelly, in support of the lower rates, "are information highways just as essential to the business prosperity of this country as the highways and waterways. It is a common-sense policy to give them advantageous rates in the mail."

Get Oil from Tar Sands

The McMurray Asphaltum & Oil Co., Ltd. of Petrolia, Ontario, Canada, has been granted concessions by the Dominion Government and has perfected a process for seperating oil from the tar sands at Fort McMurray, Alberta. Nineteen hundred acres have been leased to the company by the federal government and it is planned to spend $250,000 on initial operations.

Want License Law Administered by Engineers, Not Educators

Emmett D. McFall, an Indianapolis engineer, laid before the Scientech Club at a recent meeting a resolution expressing dissatisfaction with the way the state board for the registration of professional engineers and land surveyors is administering the law. The resolution, which was referred to the club's executive committee, read as follows:

"We believe the general dissatisfaction with the law for registration of professional engineers and land surveyors is due to the way in which the law is administered rather than to any defects in the law itself and we recommend the law be administered by a board composed of practical men in active practice and that no member of the board be connected with any educational institution."

Prof. R. L. McCormick of Rose Polytechnic Institute, is chairman of the board. Organized engineers and the board have been in dispute over the admission of a number of applicants for state license. The engineers, it was said at the club meeting, believe the board has been too theoretical in its application of the law and is barring some from receiving Indiana licenses who should receive them.

Engineer Registration Board in South Carolina Organized

The South Carolina State Board of Engineering Examiners has organized as follows: G. E. Shand, Columbia, chairman; L. S. LeTellier, Charleston, vice-chairman; and T. Keith Legare, Columbia, secretary. The board will soon have made copies of the legislative act providing for the registration of engineers and land surveyors and will have printed necessary application blanks. The other members of the board are: W. S. Tomlinson, city engineer, Columbia; and George Wrigley, Greenville.

New Jersey Engineers License Now Required

Acting under the engineers license law passed at the last session of the Legislature, the New Jersey State Board of Professional Engineers and Land Surveyors, with offices in Jersey City, is now receiving applications from those desirous of practising professional engineering and land surveying in New Jersey. A fee of $25 must accompany an application to engage in either of these professions and for those wishing a license for both a fee of $35 is charged.

Bill Proposes Postal Engineer for New York City

A bill to reorganize and improve the postal service of New York City through engineering advice by consolidating the various separate postoffices and postal districts into one district with five sub-divisions similar to the five boroughs has been introduced in the House by Representative Rossdale, of New York.

The bill proposes that the Postmaster-General appoint a qualified postal engineer and two assistant postal engineers to maintain efficiency and generally improve the service.

Ask Bid for 6-Mile Moffat Tunnel

Rapid progress has been made on the preliminaries for the six-mile Moffat tunnel under James Peak to reduce the grades and summit elevation on the Denver & Salt Lake R.R., as described in *Engineering News-Record* of May 18, pp. 811 and 836. The commission has been appointed by the governor, organization of the Tunnel District has been perfected, preliminary engineering work completed, and plans prepared. It is expected that construction contracts will be let by Sept. 1, which will give time to install the plant and camps and start the headings so as to have the work underground before severe winter conditions set in at the 9,000 ft. elevation of the tunnel.

W. P. Robinson is president of the Moffat Tunnel Commission, which has offices in the state capitol building at Denver. L. D. Blauvelt, chief engineer of the Commission, has been interested in the development of this project for several years.

Committee Studying Design of Dirigible ZR1

Review of the design of the U. S. Navy dirigible airship ZR1 by a special engineering committee has been undertaken at the request of Rear-Admiral W. A. Moffett, chief of naval aviation. The committee consists of Henry Goldmark, consulting engineer, New York, chairman; Prof. Wm. Hovgaard, professor of naval architecture at Massachusetts Institute of Technology, Boston; W. Watters Pagon, consulting engineer, Baltimore; Dr. L. B. Tuckerman, Bureau of Standards; and Dr. M. Munk, National Advisory Committee for Aeronautics.

Engineering Societies

Calendar

Annual Meetings

NEW ENGLAND WATER WORKS ASSOCIATION, Boston; Annual Convention, New Bedford, Mass., Sept. 12-15.

The American Ceramic Society will hold its summer excursion meeting Aug. 13-19, inclusive. Cities to be visited include Rochester, Montreal, Ottawa, Kingston, Toronto, Hamilton, Niagara Falls, and Buffalo.

The Engineers' Society of Pennsylvania at its recent annual meeting elected the following officers: Theodore E. Seelye, of Gannett, Seelye & Fleming, president; first vice-president, Robert W. Moorehead; second vice-president, William Brown; secretary, Howard E. Moses; treasurer, Harry T. Neale; directors, Theodore E. Seelye, Robert W. Moorehead, William Brown, Harry T. Neale, Richard V. McKay, W. Grant Rauch, J. W. Kellogg, Frank Brady, S. R. Parke, Frank M. Masters, Fred B. Harry, R. Boone Abbott, Herbert L. Thomas, R. L. Gillispie, and Gifford Pinchot.

The Arkansas Chapter of the American Association of Engineers at its recent meeting held in Little Rock listened to addresses on the Salt Lake convention and on the work done along the Mississippi levees in Arkansas by F. J. Herring and L. R. Parmelee, respectively. After the luncheon meeting, an inspection was made of the Broadway bridge across the Arkansas River.

Personal Notes

L. D. BLAUVELT, Denver, Col., has resigned as state highway engineer of Colorado in order to give all his time as chief engineer of the Moffat Tunnel Commission, which is preparing to let the contract for the 6-mile tunnel under James Peak on the Denver & Salt Lake R.R. His successor as state highway engineer has not yet been announced.

DR. J. W. TURRENTINE, formerly director of the experimental kelp-potash plant of the U. S. Department of Agriculture at Summerland, Cal., has obtained furlough from the Department for a period of six months to act as consulting chemist for the U. S. Kelp Products Corp., the newly organized concern which has purchased the government's Summerland plant and is now proceeding with the manufacture of kelp products.

FREDERICK E. BANKWITS, formerly managing engineer of the Fletcher-Thompson Co., Inc., industrial engineers of Bridgeport, Conn., has been chosen vice-president of the Seward Wire Co., of Parkersburg, W. Va., a new concern which will manufacture rubber covered insulated wire.

A. F. SCHRAMM, civil engineer of Roswell, N. M., has accepted the position of sales engineer with the Western Metal Mfg. Co., El Paso, Texas.

LYMAN P. HAPGOOD, superintendent of the Jamestown, N. Y., Water and Light Board for the past ten years, has resigned. He will be retained by the local municipal board as chief consulting engineer. MELVIN O. SWANSON, who has been a department engineer for the past two years will succeed Mr. Hapgood.

R. E. SPEAR, city engineer and assistant city manager of Ambridge, Pa., has resigned.

A. GOVETTE has been appointed superintendent of roads for the city of Longuille, Que.

C. J. COROCAN has been named superintendent of the St. Helena, Cal., municipal water works, recently purchased by the city for $60,000. Improvements costing $10,000 are planned.

E. J. PLATO has been named purchasing agent for the city of Sacramento, Cal., succeeding J. J. HALEY, who resigned to accept a position with the state department of engineering.

EDGAR S. CLOSSON, general supervisor of bridges and structures, New Jersey State Highway Department, has become associated with the Lynch Construction Co., Inc., New York City, as assistant to the president and will be in charge of construction work of the company. He was form-

erly chief engineer of the Lock Joint Pipe Co., Ampere, N. J., and in 1918-19 served as resident representative, United States Shipping Board, Emergency Fleet Corp., stationed at Mobile, Ala., in charge of all operations at the Mobile concrete ship yard.

W. C. ELY, Terre Haute, Ind., who has been a member of the board of managers of Rose Polytechnic Institute for many years, has been chosen president of the board to succeed William C. Ball, who died recently.

CREIGHTON D. BICKLEY has been appointed highway construction engineer of Essex County, N. J.

WYNKOOP KIERSTED, consulting hydraulic engineer, Kansas City, Mo., has associated with him HENRY A. STRINGFELLOW, under the firm name of Kiersted & Stringfellow, with offices in Kansas City. The firm will make a specialty of waterworks engineering.

MARSHALL G. FINDLEY, lately with Villadsen Bros., Inc., Salt Lake City, has now located with Gunvald Aus Co., consulting engineers, New York City.

LIEUT.-COL. JOHN P. HOGAN has been transferred from staff specialists R. C. to the engineer O. R. C., and assigned to the staff of G. H. Q. Engineer headquarters.

JAMES O. WANZER, formerly an engineer with the California State Highway Commission, has been elected to fill the recently-created position of city manager of Marysville, Cal.

WARREN C. EARLE on June 1 became head of the consolidated offices of city engineer and street department, city of Pasadena. E. P. DEWEY, formerly city engineer and JOHN BEYER, formerly superintendent of streets, remain with the city, the former in charge of sewage investigations and the latter as assistant street superintendent in charge of construction. Mr. Earle has held the position of consulting engineer for the city of San Diego since 1916, giving particular attention to water rights and the city's interests in utility developments generally.

RALPH H. STEARNS has severed his professional connection with Roger M. Freeman to accept a position in the hydraulic division of Sanderson & Porter, consulting engineers, New York City.

CHARLES J. BENNETT, state highway commissioner of Connecticut, received the honorary degree of Master of Arts at the recent commencement exercises at Yale University.

A. B. NEUMANN, former chief engineer of the United States Steel Corp. and recently chief consulting engineer for the Steel and Tube Company of America, has opened offices as consulting engineer in the Peoples Gas Building, Chicago. Mr. Neumann designed and built the east works of the American Rolling Mills Co., made the layout for the original plant of the Mark Manufacturing Co. in Indiana Harbor, Ind., and designed and constructed the Pittsburgh Steel Products Co.s plant at Allenport, Pa.

OBITUARY

WALTER L. HULL, city engineer of Orange, N. J., died recently after a few days' illness. Mr. Hull was first employed by the Lehigh Valley R.R. about eighteen years ago and since then worked successively with the New York Central, Pennsylvania, and Lackawanna Railroads. He was division engineer of the Lackawanna in the present grade-elevation work being carried on by that railroad in the Oranges previous to his appointment three years ago as city engineer of Orange.

CHALES J. DECKMAN, a pioneer brick manufacturer of Ohio, died recently in Cleveland. Mr. Deckman was one of the early manufacturers of brick and founded several companies in and around Cleveland for brick manufacturing more than twenty years ago. He served for two years as president of the National Paving Brick Manufacturers Association and had taken a great interest in the development of specifications for the proper construction of brick street pavements.

BUSINESS NOTES

HARRY M. WEY has been appointed manager of the Chicago district of the Pittsburgh Testing Laboratory.

FIETZ & DANIEL announces its organization to design detail structural steel and ornamental iron work, with offices in New York City.

WALTER J. EVANS has been appointed manager of the Philadelphia sales office of The Webster Mfg. Company, Chicago, Ill.

THE CHICAGO BASCULE BRIDGE CO., Chicago, Ill., has opened an eastern office at 30 Church St., New York, and has appointed J. I. Vincent, who has been connected with bascule bridge work for many years, as its eastern representative.

J. F. PARSONS, ROBERT ED and GILBERT T. ED have formed a general contracting partnership, the company to be known as the Parsons-Ed Co. The offices of the new company are at Moncton, New Brunswick.

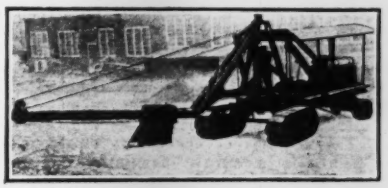
RAPP & DUNKEL, structural engineers of Pittsburgh, have dissolved partnership and J. Harold Rapp has organized his own company. The company will furnish designs for complete industrial plants and details, estimates, inspection and supervision of structural steel concrete and timber work.

L. O. HOPKINS, chief mechanical engineer of the Strauss Bascule Bridge Co., has accepted the position of chief engineer of the Chicago Bascule Bridge Co. He graduated from the University of Maine in 1905, was with the American Bridge Co. for about five years and went to the Strauss Bascule Bridge Co. in 1912.

EQUIPMENT AND MATERIALS

Skimmer Scoop Requires No Outriggers

The Bay City Dredge Works of Bay City, Mich., is putting on the market a new Bay City skimmer which does not require the use of outriggers. Outriggers are furnished on all machines as standard equipment and are necessary for clamshell work, but where the skimmer scoop is used the outriggers can be folded back out of the way. An additional point in favor of the machine is that it is equipped with a substantial brake for holding the scoop in any position on the boom. The skimmer can be operated with either



a single or double line. The single line is used for fast work in light or easy digging; the double line for slow speed in heavy work. The machine shown can be converted into a clamshell by removing the skimmer boom and putting on a clamshell boom. It is not necessary to rearrange machinery or use additional drums. The machine can also be used to operate a shovel type dipper, block and hook, electric magnet, and dragline bucket.

Out-of-the-Ordinary Trade Publications

A reference book of rules, tables, charts, and formulas for determining the correct size and capacities of reducing valves and the capacity and flow of steam in pipes of different diameters has been published by the ATLAS VALVE CO., Newark, N. J.

An excellent descriptive pamphlet which also contains considerable information of technical value on thrust bearings has been issued by the KINGSBURY MACHINE WORKS, Philadelphia, Pa.

As advance pages of its forthcoming general catalog, the SULLIVAN MACHINERY CO., Chicago, has issued Bulletin 69-M dealing with diamond core drills. The illustrated description deals with both machines and methods and offers suggestions on how to select a drilling outfit.

Equipment and methods for the distribution of concrete on construction work by means of towers and chutes form the subject of a ninety-page illustrated booklet just issued by the INSLEY MANUFACTURING CO. of Indianapolis. This publication contains much data of use to engineer and contractor in the selection and operation of concrete plants. Such matters as tower height, size of hoist bucket, size of hopper, slope of chutes, and types of chutes are discussed in detail and descriptions, illustrated by photographs and drawings, are presented for a number of typical plant installations.

Business Side of Construction

Facts and Events that Affect Cost and Volume

Contracts for June Second Heaviest Since April, 1920

Increase of $3,888,050 Over May, 1922 —$34,866,186 Greater Than Corresponding Period in 1921

With June's contracts awarded figures added to those of the preceding five months a gratifying picture of construction activity is afforded for the first half of 1922. Contracts to the value of $779,766,747 were placed, an average of $130,000,000 per month. The June total is $175,445,000 for the United States, with an additional $6,897,000 for Canada. This record was exceeded only in March, 1922, when contracts to the total amount of $191,782,262 were let. Compare this record with other half-years:

1913	$329,326,302
1920	968,685,857
1921	581,249,777

This is a straight money comparison, which ignores the changing value of the construction dollar. Reducing these figures to actual volume, by applying *Engineering News-Record's* Construction Cost Index Number, gives:

1913	100 per cent
1920	116 per cent
1921	78 per cent
1922	137 per cent

The figures in the accompanying table are compiled from Construction News, where minimum projects reach $25,000 each on public works, $40,000 on industrial construction and $150,000 in the case of commercial buildings.

Building construction throughout the United States, during June, aggregated $1,972,000 less than in May, 1922, but increased $27,155,000 over June, 1921, and exceeded the totals for June, 1920, by $52,459,958. Industrial construction for June, 1922, gained $9,869,000 the preceding month and $17,575,693 over June, 1921, and was $16,766,500 less than in June, 1920. June values for street-and-road contracts fell $2,031,000 under May, 1922, and $16,519,257 below June, 1921, but were $8,811,846 heavier than in June, 1920.

Bids Wanted on Big Jobs

Among the projects on which bids are either asked or will soon be called for in Construction News, pp. 1 to 11 are the following projects:

A tunnel project for Moffatt Tunnel District, Denver, Colo., $6,700,000.

A medical school at Cleveland, Ohio, for Western Reserve University, $1,750,000.

A department store for New York City, $2,000,000.

Paving 94,000 sq.yd., various streets, Port Arthur, Tex., $233,000.

Idle Freight Cars Fewer

Freight cars idle because of business conditions totaled 442,252 on June 15, compared with 465,837 on June 8 or a decrease of 23,585 cars, according to reports just received from the railroads of the United States by the Car Service Division of the American Railway Association.

Of the total, 268,863 were surplus freight cars in good repair, which was a reduction of 15,326 within a week. The remaining 173,389 were freight cars in bad order in excess of the normal number unfit for service.

Surplus coal cars totaled 171,832, a decrease since June 8 of 8,999, while surplus box cars amounted to 61,860 or a reduction of 3,301 within the same period. A decrease of 469 cars was reported in the number of surplus coke cars within a week, the total being 4,430, while there also was a decrease in the same period of 178 for stock cars, the total being 12,909.

Engineering News-Record Construction Cost Index Number

July, 1922	**169.70**
June, 1922	166.62
July, 1921	203.82
Peak, June, 1920	273.80
1913	100.00

Engineering News-Record's Construction Cost Index Number is three points higher than last month, due to continued stiffening in labor rates and to general rises in both cement and lumber. Steel prices are about the same as for the last two months, $1.60@$1.70, Pittsburgh. Average hourly rate for common labor is 44c. Thus, general construction cost is 17 per cent cheaper than one year ago and 38 per cent under the peak; it is 69 per cent above the 1913 level.

Engineering News-Record Construction Volume Index Number

Monthly	
June, 1922	**187**
May, 1922	179
June, 1921	117
1913	100
Yearly	
1921 (entire year)	88
1920 (entire year)	91
1913	100

Engineering News-Record's Construction Volume Index Number is 187 for the month of June, and 88 for the whole of 1921, as against 100 for 1913. This means that the actual volume of construction in 1921 (not the mere money value of the contracts let that year) is 12 per cent under the volume of construction for 1913. Our monthly volume number, 187, for June, 1922, is really the increment of construction, and indicates the rate at which contracts are being let as compared with 1913 awards.

VALUE OF CONTRACTS LET IN THE UNITED STATES AND CANADA IN JUNE, 1922

	New England	Middle Atlantic	Southern	Middle West	West of Mississippi	Western	Canada	Total
Waterworks	$849,000	$643,000	$430,000	$1,120,000	$1,082,000	$295,000	$705,000	$5,124,000
Sewers	.....	1,009,000	286,000	2,540,000	594,000	336,000	393,000	5,158,000
Bridges	121,000	4,148,000	710,000	1,408,000	965,000	920,000	353,000	8,625,000
Excav. and dredging	.....	.....	.....	427,000	366,000	1,812,000	23,000	2,628,000
Streets and roads	1,969,000	7,092,000	7,608,000	11,740,000	7,121,000	4,723,000	1,885,000	42,138,000
Industrial works	3,360,000	6,317,000	894,000	11,212,000	1,545,000	359,000	873,000	24,560,000
Buildings	3,337,000	25,642,000	6,258,000	36,739,000	8,523,000	3,232,000	2,361,000	86,092,000
Fed. government work	59,000	720,000	271,000	65,000	40,000	935,000	.....	2,090,000
Miscellaneous	1,062,000	1,558,000	666,000	1,172,000	272,000	893,000	304,000	5,927,000
Total	$10,757,000	$47,129,000	$17,123,000	$66,423,000	$20,508,000	$13,505,000	$6,897,000	$182,342,000

Organize Building Trades

The Master Builders Association of Binghamton, N. Y., at a meeting May 12 discussed plans for a united organization of all branches of the building industry in that city and engaged Alvin L. Gilmore as executive secretary of the new body. The objects of the association are as follows:

To consider subjects affecting construction and service to the public; to establish principles and standards governing the construction industry; to act as a medium of co-operation among several groups; to promote steadiness of employment among trades; to set standards of skill and honorable reputation; to promote uniformity in building laws; to promote friendly relations among employer, employe and the public; to help enforce building laws and to regulate prices.

In addition the project includes the organization of a trade school of instruction in the building trades.

Large Contracts Are Let During the Week

Among the week's announcements of contracts awarded in Construction News pp. 1 to 11 are the following large projects:

An apartment at Chicago, Ill., to Schmidt Bros. Constr. Co., 22 East Huron St., Chicago, $1,500,000.

An apartment at Chicago, Ill., to Mueller Constr. Co., 179 West Washington St., $2,000,000.

A tunnel, San Francisco, Cal., Hetch Hetchy Project, to Grant-Smith Co., San Francisco, $683,000.

A sewer, Paducah, Ky., to E. R. Harding Co., 400 Robinson Bldg., Racine, Wis., $508,000.

Labor Rates and Conditions Throughout the Country

With increased production in the iron, steel and automotive industries, sustained construction activities and marked decreases in unemployment, the striking coal miners, railroad shop workers and cotton textile operatives appear to be the only deterrents to the rapid recovery of a normal employment basis.

Men are being sought to move crops in the Middle West, laborers are in demand at the steel and other metals producing centers and the building industry is suffering from an acute shortage of skilled labor throughout the entire country. Labor rates, therefore, will continue to advance slowly in many industries.

Wage increases of 5c. per hr. in the lumber industry; 2½c.@15c. per hr. in copper and steel operations; granting bonuses or the maintenance of 1921 wage schedules in the building trades, and wage advances in the automotive, silk and paper industries are contrasted with reductions in the wages of clothing, leather, textile and railroad workers.

Until the coal strike fourteen weeks ago, miners had been operating upon a pre-war wage basis, but railway track workers were receiving 15c. per hr. in 1915, 22c. in 1917, 48½c. in May, 1920, 40c. on July 1, 1921 and have been reduced to 35c. per hr., effective July 1, 1922. This reduction represents a total of nearly $135,000,000 in the wages of about 1,250,000 railway employees as against an annual decrease of about $300,000,000 in freight receipts due to the average 10 per cent reduction.

The percentage increase in employment in various industries, according to the United States Employment Service, runs as follows: automotive, 11.2; railroads, 4.6; iron and steel, 4.5; lumber, 3.0; food, 2.9; metals, 1.5; textiles, 1.1; paper, 0.8; miscellaneous, 0.4, and chemical, 0.2 per cent.

A brief summary of local labor conditions in the building trades, as reported by *News-Record* correspondents, is as follows: **Denver**—Building trades mechanics 100 per cent employed; bricklayers receiving higher than union rates. **Detroit**—Normal in all trades. No unemployment in building trades. Local factories are increasing forces but demand is not drawing men away from construction work. **Philadelphia**—Scarcity of bricklayers and carpenters. Plenty of hoisting engineers and hodcarriers; a limited supply of structural ironworkers; enough piledrivers and common laborers. **New Orleans**—Carpenters accept 85c. per hr., without contract, as against the old rate of 88c. Hodcarriers advanced to 60c. from 40c. per hr. Negotiations, regarding wage increases, pending with structural ironworkers and hoisting engineers. Piledrivers allowed to retain 1921 wage scale. Bricklayers granted 25c. per hr. extra for sewer work. Common labor increased 5c.@10c. per hr. **Cleveland**—Labor rates only nominal, most trades receiving more. **Pittsburgh**—Enough building trades mechanics; wages of common laborers, in many instances, advanced 5c. per hr. **Montreal**—Carpenters and common laborers advanced 5c. per hr.; conditions improved. **New York**—No unemployment in building trades, steady improvement in employment in other industries. Independent Bricklayers' Helpers' Union granted continuation of 1921 wage rates, $6.50@$7 per day, effective until Jan. 1, and affecting about 6,500 cement and concrete laborers and 1,500 plasterers' laborers within the city. **Duluth**—No unemployment; wages tend to advance. Contractors bidding for men to fill crews. Common laborers receiving 40c. as against 30c. per hr. Scarcity of common labor for road and paving projects; wage rates of $3.50 per day and upward being offered.

(Higher rates indicated by +, decreases by—)

Cities	Bricklayers	Carpenters	Hoisting Engineers	Hod Carriers	Pile Drivers	Structural Iron Workers	Common Labor
Atlanta	$0.90	$0.70	$0.70	$0.30	.....	$0.65	$0.20
Baltimore	1.25	.80	.87	.54	$0.74	1.00	.30
Birmingham	1.00	.75	.50@1.00	.15@.25	.....	1.00	.15@.20
Boston	.90	.90	.90	.60	.90	.90	.55
Cincinnati	1.25	.95	.95	.72½	.77½	.95	.40
Chicago	1.10	1.00	1.10	.....	1.10	1.05	.72½
Cleveland	1.25	1.04@1.10	1.04	.60	.91	1.10	+.57½@.75
Dallas	1.00	1.00	1.00	.60	1.00	1.00	.25
Denver	1.25	1.00	1.00	.75@.81½	1.00	1.03½	.35@.50
Detroit	1.12½	.80	.80@.90	.50@.60	1.00	.60@.80	.50
Kansas City	1.07½	1.00	1.00	.80	1.07½	1.07½	.....
Los Angeles	1.25	1.00	1.00	1.12½	.87½	1.00	.56½@.62½
Minneapolis	1.00	.80	.80	.65	.....	.80	.35@.50
Montreal	.80	+.65	.50	.35	.50	.55	+.25@.35
New Orleans	1.00	—.85	.90	+.60	.80	1.00	+.35@.40
New York	1.25	1.12½	1.25	.87½	1.00	1.12½	.44@.60
Pittsburgh	1.30	1.12½	1.00	.80	1.00	1.00	+.40@.60
St. Louis	1.25	1.12½	1.12½	.85	1.00	1.05	.35@.40
San Francisco	1.12½	1.00	1.00	.75	1.00	1.12½	.47½@.50
Seattle	1.00	.80	.90	.70	1.00	.80@.90	.50@.60
Philadelphia	1.00	.90	.90	.75@90	1.00	.90	.25@.35

Suggests Courses in Bricklaying and Other Building Trades

Lack of the old-time skill and efficiency on the part of building trades mechanics is commented upon, with particular respect to bricklayers, by the Common Brick Manufacturers' Association of America, *Monthly Digest* No. 21, as follows:

"No wonder there has been complaint of a shortage of skilled building tradesmen. Figures just compiled by the Federation of Construction Industries from the last census show that in many of the trades there was a startlingly large decrease in the actual number of journeymen from 1910-1920, in two cases the decrease amounting to 23 per cent and 19 per cent respectively; and even in trades showing an increase, in practically none did this equal the 15 per cent increase in the total population.

"That such a condition exists in the huge construction industry is a matter of the gravest national concern. Everybody knows how badly we are in need of houses and of other buildings, and everybody knows how scarcity of accommodations breeds high rents and scarcity of men discourages building.

"But that is not all. It is a common complaint that workmanship on a building is not what it used to be, and this observation is not confined to any particular trade. The fact is, there never has been much attempt to train an adequate number of men to replace those who normally drop out every year and to take care of the expansion of every trade as the industry grows with the country. A large proportion of the skilled artisans now available received their training in Europe. With immigration shut off the situation will become more serious year by year unless definite steps are taken to train our young men, and to train them so thoroughly that there will be a continuance of the supply of really first-class mechanics. The most logical place in which to begin to interest our youth is in the public schools. A boy's interest in a trade can be aroused in the most vivid way by teaching him some of the simpler processes and letting him actually handle the tools and materials. We owe it to the youth of our land to "sell them the idea" of learning a trade. Too many boys take a "blind-alley" job when leaving school. Turn the boy loose with a pile of brick, a board full of mortar, a trowel and a good instructor. The bricklaying trade is a very attractive one. Many of our successful contractors have worked their way up from the ranks of the bricklayers. It is a healthy, manly, outdoor job and the only limitations on the success of a student or apprentice are the limitations imposed by his own capacity. The wages are good compared with other building trades. From the point of view of the school, to run a bricklaying class costs less than any other branch of manual training. No machinery is required, and the local brick manufacturer is generally willing to supply all the brick required either gratis or at a nominal cost."

Work on New Bridges To Start Soon

Construction of new bridges on the Louisville & Nashville R.R. across the Rigolets and Chef Menteur channels is likely to begin soon, according to a recent statement of the president of the road. The Rigolets bridge, the more important of the two, will be built first; the estimated cost is $3,128,179. It is expected that work on this structure can be taken up before the end of the current year. The bridges are noteworthy because they are directly on the gulf coast and are exposed to occasional tropical hurricanes and wave action.

Employers Are Urged To Call for Government-Trained Veterans

In all the large industrial centers, according to the United States Veterans' Bureau, men are available for positions who have been trained in the rehabilitation division of the bureau. The scope of the training includes every trade, industry, and profession, not excepting agriculture; and instruction is furnished in leading colleges, technical and commercial schools, shops and business houses, and on farms.

Employers who need men of any type are urged by the bureau to communicate with the Rehabilitation Division, Employment Section, U. S. Veterans Bureau, Washington, D. C., stating the type of personnel required, when the position will be available, and the place of employment.

Monthly Prices of Construction Materials

Ups and Downs of the Market

Pig Iron—No. 2 foundry iron up $1 in Birmingham and Chicago. Advances 40c. to 96c. per gross ton, at other principal furnaces. Coal and railroad strikes combined with sustained demand forcing prices of pig iron and other materials upward.

Railway Supplies—Light rails quoted at $30@$35 as against $30@$32 per ton, f.o.b. Pittsburgh; standard spikes $2.25 @$2.35 as compared with $2.25 per 100 lb., one month ago.

Pipe—Wrought steel pipe prices no higher despite continued demand. Higher pig-iron quotations forcing cast-iron pipe prices upward; advances of $1 in New York, $2 in Chicago and $3 per ton in Birmingham. Sewer pipe up 1c. in Philadelphia and 2c. per ft. in New York; slight rise in Minneapolis. Price reductions on sewer pipe and other construction materials, made possible by freight rate revisions, promptly outweighed by higher fuel and production costs, resulting in advances.

Road and Paving Materials—Road oils up ½c.@¾c. in New York and ¼c. per gal. in Chicago. Asphalt, in packages, down $4 in Chicago and Philadelphia and $6 per ton in Atlanta and Detroit; bulk asphalt reduced 50c. in San Francico, $4 in Chicago and Detroit and $4.50 per ton in Philadelphia. Minneapolis quotes $23.50 as against $21.35 per ton, in bulk.

Sand, Gravel and Crushed Stone—Both sand and gravel down 15c per cu. yd. in Seattle; sand up 3c. per ton and gravel 5c. per cu. yd. in Philadelphia. Crushed stone reduced 10c. per cu. yd. in Montreal. Factors determining price purely local in this group; e.g. demand, labor and transportation conditions rather than supply.

Lime—Hydrated finishing lime quoted at $15.80@$16.17 as against $15.80@ $16.80; hydrated common at $12.29, down from $12.50 per ton and common lump at $2.75@$3.14½ as compared with $2.75@$3.18 per bbl., 280 lb. net, f.o.b., New York. Changes due to freight rate adjustments.

Cement—Mill advances during June were due to higher fuel costs; 10c. at Buffington, Ind., Universal, Pa., and Steelton, Minn. Rise at mills reflected in advances in f.o.b. quotations, in sixteen important cities.

Structural Material—Steel shapes, plates and bars $1.60@$1.70, f.o.b. Pittsburgh; advance of 10c. per 100 lb. at Birmingham mills. New York warehouses quote bars at $2.58 as against $2.48; shapes and plates at $2.68 as compared with $2.58 per 100 lb., last month. Bars rolled from rails 10c. per 100 lb. higher in Chicago. Rivets up 15c. per 100 lb., Pittsburgh. Steel sheets, blue annealed, black and galvanized, advanced 15c.@25c. in Chicago and 15c. per 100 lb., New York.

Brick and Hollow Tile—Common brick quoted in New York at $21 wholesale, $24.60 delivered, as against $20 alongside dock and $23.50 per M delivered, one month ago. Advances of $1 in Pittsburgh, Minneapolis and Atlanta and 50c in Birmingham and Philadelphia. Brick demand heavy and supply light. Hollow tile slightly higher in Minneapolis and Philadelphia, lower in Atlanta.

Lumber—Prices rising because of higher labor cost and increasing demand. Long-leaf yellow pine, base sizes, up $1 in Atlanta and Minneapolis, $2 in Birmingham and Detroit, $3.50 in Dallas and $5 per M ft. b.m. in New Orleans. Similar advances in fir, hemlock and spruce.

Scrap—No. 1 railroad wrought down $1.50 and No. 1 machinery cast $1 per gross ton in New York. Cast borings quoted at $10, chemical industries, and $7, other industries, as against $9@ $9.50 per gross ton last month.

Manilla Rope—Prices down ½c. in Detroit and ¼c. per lb. in New Orleans. Heavy stocks on hand.

Explosives—Rise of ½c. in San Francisco in 60 per cent gelatin dynamite; declines of 1c. in 40 per cent and 1½c. per lb. in 60 per cent, in Seattle.

Linseed Oil—Raw quoted at 90c. as against 91c. per gal. in New York and at 96c. as compared with $1.03 per gal. (5 bbl. lots), in Chicago one month ago.

Price advances since last month are indicated by **heavy type**; declines by *italics*

PIG IRON—Per Gross Ton—Quotations compiled by The Matthew Addy Co.:

	Current	One Year Ago
CINCINNATI		
No. 2 Southern (silicon 2.25 @ 2.75)	**$23.50†**	$25.80
Northern Basic	**26.50†**	25.50
Southern Ohio No. 2 (silicon 1.75 @ 2.25)	**29.16†**	25.52
NEW YORK, tidewater delivery		
Southern No. 2 (silicon 2.25 @ 2.75)	**29.16†**	32.26
BIRMINGHAM		
No. 2 Foundry (silicon 2.25 @ 2.75)	**18.50†**	22.00
PHILADELPHIA		
Eastern Pa., No. 2X, (2.25@2.75 sil.)	**27.32†**	26.26
Virginia No. 2 (silicon 2.25 @ 2.75)	**28.74†**	27.00*
Basic	25.50†	25.00†
Grey Forge	25.00†	**24.40**
CHICAGO		
No. 2 Foundry Local (silicon 1.75 @ 2.25)	23.50†	22.00
No. 2 Foundry Southern (silicon 2.25 @ 2.75)	**25.17†**	28.67
PITTSBURGH, including freight charge from the Valley		
No. 2 Foundry Valley (silicon 1.75 @ 2.25)	**25.00†**	24.96
Basic	25.00†	23.46
Bessemer	*25.00†*	24.96

*F.o.b. furnace. † Delivered.

RAILWAY SUPPLIES

STEEL RAILS—The following quotations are per ton f.o.b. Pittsburgh and Chicago for carload or larger lots. For less than carload lots 5c. per 100 lb. is charged extra:

	Pittsburgh			
	Current	One Year Ago	Birmingham	Chicago
Standard bessemer rails	$40.00	$45.00	.....	$40.00
Standard openhearth rails	40.00	47.00	$40.00	40.00
Light rails, 8 to 10 lb	28@32	2.20@2.30*	1.60*	1.60@1.70*
Light rails, 12 to 14 lb	30@35	2.15@2.25*	1.60*	1.60@1.70*
Light rails, 25 to 45 lb	30@35	2.10@2.20*	1.60*	1.60@1.70*
Rerolled Rails	28.00	.....	.....	.....

*Per 100 lb.

RAILWAY TIES—For fair-sized orders, the following prices per tie hold:

	6 In. x 8 In. by 8½ Ft.	7 In. x 9 In. by 8½ Ft.
Chicago, White Oak	$1.35	$1.50
Chicago, Hardwood and Red Oak	1.20	1.30
Chicago....Empty Cell Creosoting (add'l)	.45	.50
San Francisco..... Green Douglas Fir	.85	1.10
San Francisco, Empty Cell Creosoted, Douglas Fir	1.86	2.30
St. Louis, White Oak*	1.10	1.44
St. Louis, Red Oak*	.97	1.17
St. Louis (creosoted)	No. 1, $0.86;	No. 2, $0.96; No. 4, $1.28

*Standard specifications 38c. per tie additional. Zinc chloride process 27c. per tie additional.

TRACK SUPPLIES—The following prices are base per 100 lb. f.o.b. Pittsburgh for carload lots, together with the warehouse prices at the places named:

	Pittsburgh					San Francisco	Birmingham
	Current	One Year Ago	Chicago	St. Louis			
Standard spikes, ⅝-in. and larger	$2.25@2.35	$3.25@3.40	$2.55	$3.00	$4.10	*$2.80*	
Track bolts	3.25	4.00@4.35	3.65	4.25	5.10	*3.80*	
Standard section angle bars	2.40	2.50	2.40	3.00	4.00	*3.00*	

PIPE

WROUGHT PIPE—The following discounts are to jobbers for carload lots on the latest Pittsburgh basing card:

BUTT WELD

Inches	Steel Black	Galv.	Inches	Iron Black	Galv.
1 to 3	71	58½	⅜ to 1¼	44½	29½

LAP WELD

2	64	51½	2	39½	25½
2½ to 6	68	55½	2½ to 4	42½	29½
7 to 8	65	51½	4½ to 6	42½	29½
9 to 12	64	50½	7 to 12	40½	27½

BUTT WELD, EXTRA STRONG, PLAIN ENDS

1 to 1¼	69	57½	⅜ to 1¼	44½	30½
2 to 3	70	58½			

LAP WELD, EXTRA STRONG, PLAIN ENDS

2	62	50½	2	40½	27½
2½ to 4	66	54½	2½ to 4	43½	31½
4½ to 6	65	53½	4½ to 6	42½	30½
7 to 8	61	47½	7 to 8	35½	23½
9 to 12	55	41½	9 to 12	30½	18½

STEEL PIPE—From warehouses at the places named the following discounts hold for steel pipe:

	Black			Galvanized		
	New York	Chicago	St. Louis	New York	Chicago	St. Louis
1 to 3 in. butt welded	66%	62½%	59%	53%	48½%	45%
2½ to 6 in. lap welded	61%	59½%	56%	47%	45½%	42%

Malleable fittings, Class B and C, from New York stock sell at list less 10%. Cast iron, standard sizes, *32-5%* off.

CAST-IRON PIPE—The following are prices per net ton for carload lots:

	Birmingham Mill	New York One Current	New York Year Ago	Chicago	St. Louis	San Francisco
4 in.	**$42.00**	**$55.80**	$53.30	**50.60**	$43.70	$55.00
6 in. and over	**37.50**	**50.80**	48.30	**46.60**	39.70	51.00

Gas pipe and Class "A," $4 per ton extra; 16-ft. lengths, $1 per ton.

CLAY DRAIN TILE—The following prices are per 1000 lin.ft.:

Size, In.	New York Current	New York One Year Ago	St. Louis	Chicago	San Francisco	Dallas
3	$40.00	$50.00	.....	$50.00	.....	**$55.00**
4	50.00	60.00	$80.00	60.00	$76.50	65.00
5	80.00	90.00	.....	80.00	97.75	84.00
6	100.00	115.00	140.00	100.00	127.50	110.00
8	150.00	185.00	200.00	150.00	212.50	181.00

SEWER PIPE—The following prices are in cents per foot for standard pipe in carload lots, f.o.b., except as otherwise stated:

Size, In	New York Delivered	Pittsburgh	Birmingham	St. Louis	Chicago	San Francisco	Dallas
3	**$0.16**	$0.087	.....	.....	$0.12	$0.12	.....
4	**.16**	.087	$0.09	$0.0875	.12	.15	**$0.18**
5	**.22**	.1305	.1125	.....	.18	.18	**.165**
6	**.22**	.1305	.135	.1225	.18	.21	**.23**
8	**.37**	.203	.225	.20	.28	.30	**.35**
10	**.54**	.3045	.2925	.28	.42	.42	.....
12	**.70**	.3915	.3825	.36	.54	.54	**.80**
15	**1.20†**	.522	.5625	.52	.72	.90	.....
18	**1.65†**	.725	.765	.68	1.00	1.32	.....
20	**2.10†**	.87	.....	.92	1.20	.....	.....
22	**2.70†**	1.16	.....	.....	1.60	.....	.....
24	**3.05†**	1.305	1.50	1.20	1.80	2.16	**2.40**
27	**4.70†**	2.34	.....	2.00	3.75†	3.00	.....
30	**5.20†**	2.59	.....	2.45	4.75†	3.60	.....
33	**6.70†**	3.51	.....	3.00	5.50†	.....	.....
36	**7.70†**	4.00	.....	3.25	6.00†	.....	.....
	3		5	8	12	24	36
Boston	$0.105		$0.1575	$0.245	$0.4725	$1.575	$4.408
Minneapolis	.....		.....	.40	*.72*	**2.557**	**5.667†**
Denver	.135*		.18*	.27	.47	1.70	.....
Seattle	.13		.....	.32½	.65†	2.34†	.....
Los Angeles	.11*		.165*	.275	.495	1.65	.....
New Orleans	.....		.106	.27	.459	1.755	.....
Cincinnati	.096		.144	.224	.43	1.44	4.382†
Atlanta	.085*		.1275*	.21	.355	1.37	.....
Montreal, *delivered*	.30*		.45*	.70	1.35	4.50	.....
Detroit	.099		.1485	.231	.4455	1.935	5.125†
Baltimore	.1225		.2275	.35	.6870	2.29	5.23
Kansas City, Mo	.15*		.21*	.335	.60	2.41	4.74
Philadelphia	.105		.1575	**.250**	**.48**	**1.58**	**3.60†**

*4-in., 6-in., 9-in., respectively. †Double Strength.

ROAD AND PAVING MATERIALS

ROAD OILS—Following are prices per gallon in tank cars 8,000 gal. minimum f.o.b. place named:

	Current	One Year Ago
New York, 45% asphalt (at terminal)	$0.05	$0.06½
New York, 65% asphalt (at terminal)	.045	.06
New York, binder (at terminal)	**.0575**	.07
New York, flux (at terminal)	**.055**	.06½
New York, liquid asphalt (at terminal)	.06	.08
St. Louis, 30-50% asphalt (*f.o.b.*) *Wood River, Ill.*	.05	.02½*
Chicago, 40-50% asphalt	**.05½**	.06
Chicago, 60-70% asphalt	**.05½**	.06½
Dallas, 40-50% asphalt	.10	.10
Dallas, 60-70% asphalt	.13	.13
Dallas, 75-90% asphalt	.15	.15
San Francisco, binder, per ton	13.00†	15.00

* Freight $21.75 per ton to Whiting, Ind.
† F.o.b. Oleum, Cal. Freight to San Francisco, 80c. per ton.

ASPHALT—Price per ton in packages (350-lb. bbls. or 425-lb. drums) and in bulk in carload lots:

	Package	Bulk
New York (dock 1) (*Mexican*)	$17.50	$13.00
Boston (*Mexican*)	18.50	14.00
Chicago (*Standard*)	*20.35*	*14.00*
San Francisco, *f.o.b. refinery*, Oleum, Cal.	19.50*	*13.00**
Dallas, *petroleum*	35.00	27.00
Seattle "D" grade (*California*)	23.75	27.25†
Denver (*California*)	40.00	....
Minneapolis *f.o.b. Twin Cities* (*Mexican*)	29.00	23.50
St. Louis (*Mexican*)	22.35	14.00
Baltimore (*Mexican*)	*18.00*	*13.00*
Los Angeles, *at factory, Bakersfield* (*California*)	22.50	15.00
Montreal (*Mexican*)	28.00	21.00
Atlanta (*Mexican*)	*22.00*	16.50
Detroit (*Texas*)	*19.00*	*15.00*
Cincinnati	32.00	28.00
Maurer, N. J. (*Trinidad and Bermudez*)	*28.50*	*26.50*
Maurer, N. J. (*Mexican*)	*18.50*	*16.50*
Philadelphia (*Mexican*)	*18@20*	*13.00*
Kansas City, *petroleum*	28.83	22.83

*Freight to San Francisco, 80c. per ton.

†Petrolastic XX.

NOTE—Barrels or drums are optional in most cities. About 6 bbls. to the ton, and from 4 to 5 drums. Rebates of about $1 per bbl., no rebate for drums.

PAVING STONE—

New York *delivered*	5-in. granite, 28@29 blocks per sq.yd.	$131.75 per M
Chicago	About 4x8x4 dressed	3.20 sq.yd.
	About 4x8x4 common	3.00 sq.yd.
San Francisco	Basalt block 4x7x8	70.00 per M
Boston	5-in. granite	125.00 per M
Atlanta	Granite	2.00 sq.yd.
Detroit	Granite, 26½ blocks per sq.yd.	100.00 per M
Baltimore	Granite	2.00 sq.yd.
Montreal *delivered*	Granite	100.00 per M
New Orleans	Granite, 4 x 8 x 4	3.25 sq.yd.
Cincinnati	Granite	3.84@4 sq.yd.
St. Louis	4x8x4 dressed	3.35 sq.yd.
	4x8x4 common	3.00 sq.yd.
Kansas City	No. Granite	3.95 sq.yd.
Philadelphia	Granite	125.00 per M.

FLAGGING—

New York	Bronx	$0.25 sq.ft.
	Manhattan, 4 ft.	.26 sq.ft.
	Queens, 5 ft.	.26 sq.ft.
	6x20-in. cross-walk	1.00 lin.ft.
Chicago	18 in. wide	.99 lin.ft.

CURBING—Bluestone per lineal foot, in New York, costs 77c. for 5x16 in., 88c. for 5x18 in.; in cargo lots.

WOOD BLOCK PAVING—

	Size of Block	Treatment	Per Sq.Yd.
New York (*delivered*)	3	16	$2.04
New York (*delivered*)	3½	16	2.17
New York (*delivered*)	4	16	2.36
Boston	3	16	2.17
Chicago	4	16	3.00@3.25
Chicago	3½	16	2.50
St. Louis	3½	16	2.50
St. Louis	4	16	3.00
Seattle	4	16	Off market
Minneapolis	3½	16	2.09
Atlanta	3½	16	2.30
New Orleans	3	16	1.60
New Orleans	3½	16	1.80
New Orleans	4	16	2.00
Dallas	4	18	3.90
Baltimore	3½	16	3.44
Montreal	4	16	4.50
Detroit	3	16	2.84
Detroit	4	16	3.00
Cincinnati	4	16	2.10
Kansas City	4	16	2.15
Philadelphia	3½	16	3.80

CONSTRUCTION MATERIALS

SAND AND GRAVEL—Price for cargo or carload lots to contractor is as follows, per cu.yd.:

	Gravel 1½ In. Current	Gravel 1½ In. One Year Ago	Gravel ¾ In. Current	Gravel ¾ In. One Year Ago	Sand Current	Sand One Year Ago
New York	$1.75	$2.50	$1.75	$2.50	$1.00	$1.25
Denver	*1.75*	2.00	*1.75*	1.80	*0.75*	1.60
Chicago	1.80	2.25	1.80	2.25	1.80	2.25
St. Louis, *per ton*	1.25	1.55	1.30	1.60	1.10	1.60*
Seattle	*1.10*	1.50	*1.10*	1.50	*1.10*	1.50
Dallas	2.25	3.50	2.25	4.00	2.25	3.00
Minneapolis	1.50	2.00	1.50	....	1.00	1.00
Cincinnati	1.87½	2.25	1.87½	2.30	1.43	1.65
San Francisco	2.25	2.25	2.25	2.50	1.50	1.50
Boston	2.40	2.65	2.40	2.65	1.65	2.00
New Orleans	2.08½	2.85	2.08½	....	1.35	1.35
Los Angeles, per ton	1.50†	1.45†	1.50†	1.45†	1.35†	1.30†
Atlanta, per ton	1.85	2.35	1.85	....	1.15	1.40
Detroit	2.00	2.25	2.00	2.25	2.00	2.25
Baltimore, per ton	1.40	1.40	1.60	1.60	2.00	.70
Montreal, per ton	1.25	1.50	1.50	1.50	1.25	1.25
Birmingham, per ton (Crushed slag used instead of gravel)					1.22	1.43‡
Philadelphia	1.55	....	1.60	....	1.60	....
Kansas City	2.00	....	2.00	....	1.20	....

* Fine white sand: Pacific, $5 per ton; Ottawa, $6.

† Freight from quarry to Los Angeles is 85c. per ton, and is included in above price.

‡ Per cu. yd.

CRUSHED STONE—Price for cargo or carload lots f.o.b. city, unless stated otherwise, is as follows, per cu.yd.:

	1½ In. Current	1½ In. One Year Ago	¾ In. Current	¾ In. One Year Ago
New York	$1.65	$1.90@2.00	$1.75	$2.15
Chicago	1.60	2.50	1.60	2.50
St. Louis *delivered*	1.65	2.60*	1.65	2.60*
Dallas, *delivered*	2.73	2.80	2.73	2.80
San Francisco	2.25	2.25	2.25	2.50
Boston, *delivered*	3.00*	3.00* (del.)	3.00*	3.00* (del.)
Minneapolis, *at plant*	2.00	2.00	2.25	2.25
Kansas City, *at plant*	2.10	1.25	2.10	1.40
Denver	3.50	....	3.50	....
Seattle *delivered*	3.00	3.00 (del.)	3.00	3.00 (del.)
Atlanta	1.90*	2.25*	1.90*	....
Cincinnati *delivered*	1.75	3.24	1.75	3.24
Los Angeles	1.75*	1.50*	1.85*	1.80*
Detroit	1.90*	2.00*	1.90*	2.00*
Baltimore	1.75*	1.75*	1.65*	1.75*
Montreal	*1.90**	2.00*	2.00*	2.10*
Birmingham *delivered*	3.20	....	3.10	....
Philadelphia	1.70*	....	1.55*	....
Pittsburgh	2.85	....	2.85	....
Cleveland	3.00*	....	3.00*	....

*Per ton.

CRUSHED SLAG—Price of crushed slag in carload lots, per net ton, at plants:

	1½-In.	¾-In.	Roofing	Sand
Youngstown District	$1.30	$1.30	$2.00	$1.30
Steubenville District	1.40	1.40	2.00	1.40
Ironton District	1.40	1.40	2.00	1.40
Emporium, Pa.	1.25	1.25	....	1.25
Easton, Catasaqua, Pa.	1.00	1.00	2.00	0.90
Birmingham, Ala.	*0.75*	*0.75*	....	*0.75*
Buffalo, N. Y., and Erie, Pa.	1.25	1.25	2.25	1.25
Cleveland, Ohio	1.20	1.20	....	1.00
Eastern Pennsylvania and Northern New Jersey	1.20	1.20	2.00	1.20
Western Pennsylvania	1.25	1.25	2.00	1.25

LIME—Warehouse prices:

	Hydrated, per Ton Finishing	Hydrated, per Ton Common	Lump, per Barrel Finishing	Lump, per Barrel Common
New York	$15.80@*16.17*	*$18.29*	$3.68½*	$2.75@*$3.14½**
Chicago	18.00			1.40†
St. Louis	23.20	20.00	2.35†	....
Boston	23.00	19.00	3.30†	3.00†
Dallas	25.00			2.50†
Cincinnati	15.10	12.50	10.75‡	12.50‡
San Francisco	22.00	18.00		1.75†
Minneapolis	29.00	22.00 (white)	1.70†	1.40†
Denver	24.00		....	2.70†
Detroit	18.00	16.00		17.00‡
Seattle *paper sacks*	24.00		2.80†	
Los Angeles	30.00	30.00	3.00*	3.00*
Baltimore	15.00	13.00		12.00‡
Montreal	21.00	21.00	15.00‡	11.00‡
Atlanta	22.50	13.00	2.00†	1.75†
New Orleans		17.25	1.75†	
Philadelphia	13.00	12.00	10.50‡	9.50‡

*Per 280-lb. bbl. (net). †Per 180-lb. bbl. (net). ‡Per ton—Refund of 10c. per bbl. Minneapolis quotes brown common lump lime; Kelly Is. white is $1.70, Sheboygan $1.55. New York quotes hydrated lime "on cars" in paper sacks; lump lime "alongside dealers docks" or "on cars."

NATURAL CEMENT—Price to dealers per bbl. for 500 bbl. or over, f.o.b., exclusive of bags:

	Current	One Year Ago
Minneapolis (Rosendale)	$2.80	$2.80
Kansas City (Ft. Scott)	1.60	1.60
Atlanta (Magnolia)	11.00 ton	11.00
Cincinnati (Utica)	1.77	1.87
Boston (Rosendale) per bag	.80	2.85
St. Louis (Carney hydrated)	2.10	....

PORTLAND CEMENT—Prices to contractors per bbl. in carload lots f.o.b. points listed *without bags*. Cash discount not deducted.

	Current	One Month Ago	One Year Ago
New York, del. by truck	$2.40@2.50	$2.40@2.50	$2.80
New York, alongside dock to dealers	2.10	2.10	2.40
Jersey City, del. by truck	2.28	2.32	2.89
Boston	2.50	2.50	2.86
Chicago	2.05	1.97	2.17
Pittsburgh	2.09	2.02	2.17
Cleveland	2.31	2.26	2.43
Detroit	2.33	2.17	2.43
Indianapolis	2.26	2.21	2.43
Toledo	2.33	2.20	2.49
Milwaukee	2.22	2.16	2.39
Duluth	2.62	1.94	2.10
Peoria	2.26	2.08	2.45
Cedar Rapids	2.33	2.21	2.51
Davenport	2.28	2.14	2.47
St. Louis	2.20	2.20	3.00
San Francisco	2.63	2.83	3.09
New Orleans	3.20	3.00	3.36
Minneapolis	2.29	2.24	2.41
Denver	2.90	2.90	3.10
Seattle	*2.90*	2.94	3.10
Dallas	2.25	2.25	2.60
Atlanta	2.34	2.34	2.60
Cincinnati	2.39	2.35	2.57
Los Angeles	3.30	3.30	3.31
Baltimore, del. by truck	2.50	2.50	3.58
Birmingham	*2.10*	2.27	3.05
Kansas City	2.40	2.40	3.20
Montreal	2.88	2.48	....
Philadelphia	2.31	2.21	....
St. Paul	2.29	2.24	2.41

NOTE—Bags 10c. each, 40c. per bbl.;

Current mill-prices per barrel in carload lots, without bags; to contractors:

Buffington, Ind.	$1.80	Mason City, Ia.	$1.95
Universal, Pa.	1.85	Hudson, N. Y.	2.00
Steelton, Minn.	1.85	Leeds, Ala.	1.85
Fordwick, Va.	1.95	Hannibal, Mo.	1.85
Mitchell, Ind.	1.95	Lehigh Valley District	1.90
LaSalle, Ill.	1.70	Kingsport, Tenn.	1.95
Iola, Kan.	1.95	Richard City, Tenn.	1.95

TRIANGLE MESH—Price per 100 sq.ft. in carload lots:

PLAIN 4-INCH BY 4-INCH MESH

Style Number	Weight in Pounds per 100 sq.ft.	Pittsburgh, Mill	Warehouse: New York	Chicago	Dallas	San Francisco
032	22	$0.68	$0.95	$0.76	$1.15	$1.15
049	28	.87	1.23	.98	1.46	1.48
068	35	1.05	1.48	1.18	1.80	1.80
093	45	1.35	1.91	1.52	2.30	2.32
126	57	1.65	2.35	1.87	2.86	2.87
153	68	1.97	2.81	2.23	3.40	.....
180	78	2.26	3.22	2.56	3.93	.....
245	103	2.99	4.25	3.38	5.15	.....
287	119	3.45	4.90	3.90	5.96	6.01
336	138	4.00	5.69	4.52	7.32	.....
395	160	4.64	6.60	5.20	8.00	.....
PAVING						
036P	17	$0.52	$0.72	$0.58	$0.88	.....
053P	24	.73	1.02	.82	1.24	.....
072P	31	.91	1.29	1.00	1.57	.....
097P	40	1.18	1.67	1.29	2.02	.....
049R	24	.73	1.02	.67	1.24	.....
067R	31	.91	1.29	1.00	1.57	.....
089R	40	1.18	1.67	1.29	2.02	.....

In rolls 16-, 20-, 24-, 28-, 32-, 36-, 40-, 44-, 48-, 52-, and 56-in. wide and in 150-, 200- and 300-ft. lengths Galvanized is about 15% higher. Size of roll carried in New York warehouses, 48 in wide x 150 ft. long, or 600 sq. ft.

EXPANDED METAL LATH—Prices in carload lots per 100 yd. for painted are as follows:

Gage	Weight	*New York	Chicago	St. Louis	San Francisco	Dallas
27BB	2.3	*$17.50*	$20.39	$21.25	$23.87	$25.50
26BB	2.5	*17.50*	22.00	22.75	26.21	27.56
25BB	3.0	*20.00*	.....	27.10	.....	30.71
24BB	3.4	*21.50*	26.33	29.25	27.90	33.16
22PO	4.33	*24.50*	31.00	31.75	.....	35.10

* Price to contractors at warehouse or delivered on job in Manhattan, Bronx or Brooklyn.

BARS, CONCRETE REINFORCING—Current quotations per 100 lb.:

ROLLED FROM BILLETS

Inches	Pittsburgh Mill	Birmingham Mill	Warehouse, Uncut: New York	Chicago	St. Louis	Dallas	San Francisco
½ and larger	$1.60@1.70	$1.85	$2.58	$2.58	$2.47½	$3.50	$2.55
⅝ and larger	1.65@1.75	1.90	2.63	2.63	2.52½	3.55	2.60
¾ and larger	1.70@1.80	1.90	2.68	2.68	2.57½	3.60	2.65
⅞ and larger	1.85@1.95	1.95	2.73	2.83	2.72½	3.75	2.80
1 and larger	2.10@2.20	1.95	2.78	3.08	2.97½	4.00	3.05

Includes 15c charge for cutting to lengths of 2 ft. and over.
Twisted bars cut to length take extra of 27½c. per 100 lb.

ROLLED FROM RAILS

	Chicago	St. Louis	Dallas		Chicago	St. Louis	Dallas
½ and larger	$1.70	$2.25	$3.25	½	$1.95	$2.50	$3.50
⅝ in.	1.75	2.30	3.30	¼	2.20	2.75	3.75
¾	1.80	2.35	3.35		.....	.....	.....

BRICK—Contractors price per 1,000 in cargo or carload lots is as follows:

	Common: Current	One Month Ago	One Year Ago	Paving Block: 3-inch*	4-inch*
New York (del.)	24.00	$23.50	$18.40	*$40.00†*	*$45.00†*
New York (at dock)	21.00	20.00	15@15.50	.....	.....
Chicago	11.00	11.00	12.00	34.00	42.00
St. Louis, salmon	14.00	14.00	17.00	.....	28.00
Denver, salmon	12.00	12.00	14.00	.....	.....
Dallas	11.15	11.15	12.50	no market	
San Francisco	15.00	15.00	18.00	.....	.....
Los Angeles (del.)	15.00	15.00	15.50	(not used)	
Boston (del.)	16.00	16.00	20.00	*49.00†*	*47.50†*
Minneapolis (del.)	17@18	16@17	17.00	.....	43.00
Kansas City	14.50	14.50	15.50	.....	.....
Seattle	14.00	14.00	14.00	44.00	.....
Cincinnati	15.00	15.00	18@20	41.00	36.50
Montreal	16.00	16.00	18.00	.....	68.00
Detroit (del.)	16.50	16.50	16.25@18	36.50	39.50
Baltimore (del.)	20.00	20.00	25.00	36.00‡	.....
Atlanta	11.00	10.00	15.00	.....	.....
New Orleans	12.50	12.50	14.50	.....	.....
Birmingham	12.00	11.50	.....	.....	.....
Philadelphia	17@18	16.50@17.50	16.50@17.50	.....	44.00
Pittsburgh (del.)	16@18	16.00	.....	.....	.....
Cleveland	14.00				

* For paving blocks 3½x8½x3 and 3½x8½x4 respectively. † F.o.b. ‡ Vitrified, f.o.b. plant, Baltimore.

HOLLOW TILE—Price per block in carload lots to contractor for hollow building tile.

	New York: Current on Trucks*	One Year Ago	Chicago	Philadelphia	St. Louis	San Francisco	Perth Amboy N. J., Factory*
4x12x12	$0.11120	$0.12320	$0.0707	$0.10	$0.0635	$0.108	.....
6x12x12	.16670	.1642	.0973	.....	.08	.156	.....
8x12x12	.20840	.219	.1326	.18	.12	.244	$0.17890
10x12x12	.....	.....	.1621	.....	.16	.....	.21050
12x12x12	.....	.....	.1853	.....	.185	.....	.27370

* 5 per. off for cash.

	4x12x12	8x12x12	12x12x12
Boston	$0.94	$0.177	$0.244
Minneapolis (f.o.b. cars)	.076	.12475	.220
Minneapolis (delivered)	.086	.14625	.245
Cincinnati	.0670	.1263	.175
Kansas City	.085	.167	.270
Denver	.08	.145	.21
Seattle (delivered)	.12	.25	.30
Los Angeles factory	.095	.176	.22
New Orleans	.12	.23	.36
Detroit (delivered)	.070	.135	.225
Montreal	.09	.145	.30
Baltimore	.14	.25	.39
Atlanta	.072	.120	.....
Dallas	.115	..	.....
Birmingham	.10	.17	.....
Pittsburgh (del.)	.068	.128	.179
Cleveland	.065	.143	.....

San Francisco, Philadelphia, Atlanta, New York, quote on hollow partition tile.

STRUCTURAL MATERIAL—Following are base prices f. o. b. mill, Pittsburgh and Birmingham together with quotations per 100 lb. from warehouses at places named:

	Pittsburgh, Mill	Birmingham Mill	New York	Dallas	St. Louis	Chicago	San Francisco
Beams, 3 to 15 in.	1.60@1.70	$1.95	$2.68	$4.00	$2.57½	$2.68	$3.10
Channel, 3 to 15 in.	1.60@1.70	1.95	2.68	4.00	2.57½	2.68	3.10
Angles, 3 to 6 in., ¼ in. thick	1.60@1.70	1.95	2.68	4.00	2.57½	2.68	3.10
Tees, 3 in. and larger	1.60@1.70	1.95	2.68	4.00	2.57½	2.68	3.10
Plates	1.60@1.70	1.95	2.68	4.00	2.57½	2.68	3.10

RIVETS—The following quotations are per 100 lb.:

STRUCTURAL

	Warehouse: Pittsburgh, Mill	New York: Current	New York: One Yr. Ago	Chicago	St. Louis	San Francisco	Dallas
½ in. and larger	$2.40	$3.60	$4.65	$3.10	$3.09½	$4.25	$5.50
CONE HEAD BOILER							
½ in. and larger	2.50	3.70	4.75	3.20	3.19½	4.35	5.65
⅝ and ¾	2.65	3.86	4.90	3.35	3.35½	4.50	5.80
⅞ and 1	2.90	4.10	5.15	3.60	3.59½	4.75	6.05

Lengths shorter than 1 in. take an extra of 50c. Lengths between 1 in. and 2 in. take an extra of 25c.

NAILS—The following quotations are per keg from warehouse:

	Pittsburgh, Mill	Chicago	San Francisco	Dallas	St. Louis	Montreal
Wire	$2.40	*$3.10*	$3.90	$5.00	$3.25	$4.95
Cut	2.25	*5.50*	5.90	7.75	....	5.00

PREPARED ROOFINGS—Standard grade rubbered surface, complete with nails and cement, costs per square, f.o.b., as follows:

	New York: 1-Ply l.c.l.	2-Ply l.c.l.	3-Ply l.c.l.	Philadelphia: 1-Ply l.c.l.	2-Ply l.c.l.	3-Ply l.c.l.
No. 1 grade	$2.10	$2.55	$3.00	$1.90	$2.35	$2.80
No. 2 grade	1.85	2.15	2.55	1.70	2.00	2.40

Slate-surfaced roofing (red and green) in rolls of 108 sq.ft. costs $1.95 per roll in carload lots and $2.20 for smaller quantities f.o.b. Philadelphia.

Single shingles, red and green slate finigh, cost $5.50 per package (sufficient to cover 50 sq.ft.) in carloads; $5.75 in smaller quantities, in Philadelphia. Strip shingles (4 in 1) f.o.b. Philadelphia. l.c.l., $5.60

ROOFING MATERIALS—Prices f.o.b. New York:

Tar felt (14 lb. per square of 100 sq.ft.) per roll of 432 sq.ft	$2.00
Tar pitch (in 400-lb. bbl.), per 100 lb	1.60
Asphalt roofing (in barrels), per ton, f.o.b. plant*	40.50
Asphalt felt (light), per ton, f.o.b. plant*	64.50
Asphalt felt (heavy), per ton, f.o.b. plant*	68.50

* Delivered in Metropolitan Dist., $3.00 additional.

SHEETS—Quotations are per 100 lb. in various cities from warehouse also the base quotations from mill:

Blue Annealed	Pittsburgh, Large Mill Lots	St. Louis	Chicago	San Francisco	New York
No. 10	$2.40	$3.62½	$3.63	$4.15	$3.63
No. 12	2.45	3.67½	3.68	4.20	3.68
No. 14	2.50	3.72½	3.73	4.25	3.73
No. 16	2.70	3.82½	3.83	4.35	3.83
Black					
*Nos. 18 and 20	3.00	3.70	4.30	5.45	4.15
*Nos. 22 and 24	3.05	3.85	4.30	5.50	4.20
*No. 26	3.10	4.00	4.35	5.55	4.25
*No. 28	3.15	4.30	4.45	5.65	4.35
Galvanised					
No. 10	3.15	4.30	4.45	....	4.35
No. 12	3.25	4.40	4.55	5.60	4.45
No. 14	3.25	4.40	4.55	5.60	4.45
Nos. 17 to 21	3.55	4.60	4.85	5.90	4.75
Nos. 22 and 24	3.70	4.85	5.00	6.05	4.90
*Nos. 25 and 26	3.85	5.00	5.15	6.20	5.05
*No. 28	4.15	5.30	5.45	6.50	5.35

*For painted corrugated sheets add 30c. per 1,000 lb. for 5 to 28 gage; 25c. for 19 to 24 gage; for galvanized corrugated sheets add 15c., all gages.

LINSEED OIL—These prices are per gallon:

	New York: Current	New York: One Year Ago	Chicago: Current	Chicago: One Year Ago
Raw in barrel (5 bbl. lots)	*$0.90*	$0.80	*$0.96*	$0.75

WHITE AND RED LEAD—Base price in cents per pound:

	Red				White	
	Current		1 Year Ago		Current	Yr. Ago
	Dry	In Oil	Dry	In Oil	Dry or In Oil	Dry or In Oil
100-lb. keg	12 50	14 00	13.00	14.50	12 50	13 00
25 and 50-lb. kegs	12 75	14.25	13.25	14.75	12.75	13.25
12½-lb. keg	13 00	14.50	13.50	15.00	13 00	13.50
5-lb. cans	15 50	17 00	16.00	17.50	15.50	16.00
1-lb. cans	17 50	19.00	18.00	19.50	17.50	18.00

LUMBER

Prices wholesale to dealers in carload lots, f.o.b.

San Francisco—Prices of rough Douglas fir No. 1 common, in carload lots to dealers at yards. To contractors, $2 per M ft. additional.

	6–8 and 12 Ft.	10–16–18 and 20 Ft.	22 and 24 Ft.	25 to 32 Ft.
3x3 and 4	$28 00	$31 00	$31 00	$33 00
3x6 and 8	28 00	31 00	31 00	34 00
4x4-6 and 8	28 00	31 00	32 00	35 00
3x10 and 12	28 00	31 00	32 00	36 00
3x14	32 00	33 00	34 00	36 00
4x10 and 12	28 00	31 00	32 00	35 00
4x14	32 00	33 00	34 00	36.00

	24 Ft. and Under	25 to 32 Ft.	33 to 40 Ft
6x10	$30 00	$33 00	$35 00
6x14	32 00	35 00	37 00
8x10	30 00	33 00	35 00
8x14	32 00	35 00	37 00

New York and Chicago—Wholesale prices to dealers of long leaf yellow pine.

	New York*		Chicago	
	20 Ft. and Under	22–24 Ft.	20 Ft. and Under	22–24 Ft.
3x 4 to 8x8	$38.00	$39.00	$42 00	$45 00
3x10 to 10x10	41.00	42.00	46 00	48 00
3x12 to 12x12	44.00	45 00	49 00	51 00
3x14 to 14x14	47.50	48.50	52 00	55 00
3x16 to 16x16	52.50	53.50	57 00	59 00
3x18 to 18x18	60.00	61.00	64 00	67 00
4x20 to 20x20	70.00	71.00	74 00	77.00

*Wholesale price to dealers; to contractors, delivered from lighters or cars to job, $5 additional. Short leaf pine up to 14 x 14 costs $15 per M. less.

Over 24 ft.—Add $1 for each additional 2 ft. in length up to 30 ft. for sizes 12 x 12 and under, for sizes over 12 x 12 add $2, for merchantable add $2 to sizes 10 x 10 and under. For pine add $2 to the price of merchantable for all sizes.

Other Cities	8 x 8-In. x 20 Ft. and Under				12 x 12-In. 20 Ft. and Under	
	P.	Fir	Hemlock	Spruce	P.	Fir
Boston	$50.00	$52.00	$55.00	$45.00	$54.00	$52.00
Seattle	.....	22.50	.....	.....	.....	22.50
New Orleans	30 00	.....	.....	.....	35 00	.....
Baltimore	36 45	.....	.....	.....	38.50	.....
Cincinnati	39.00	50.00	.....	.....	40.00	64.00
Montreal	78.00	45.00	35.00	38.00	78.00	47.00
Los Angeles	.....	44.00	43.00	.....	.....	44.00
Denver	.....	38 00	38 00	38.00	.....	51 00
Minneapolis	45 00	41.00	40.00	.....	48.00	41.00
Atlanta	33 50	.....	.....	.....	39 00	.....
Dallas	37 50	.....	.....	.....	39 00	.....
Kansas City	33.00	34.00	.....	.....	36.00	35.00
Birmingham	23 00	.....	.....	.....	28.00	.....
Philadelphia	36.50	39.00	42.50	48.00	46.50	38.50
Detroit	41.25	44.00	.....	.....	47 00	46.00
St. Louis	35.00	.....	.....	.....	38.00	.....

	1-In. Rough, 10 In. x 16 Ft. and Under			2-In. T. and Gr. 10 In. x 16 Ft.	
	P.	Fir	Hemlock	P.	Fir
Boston	$47.00	$48.00	$32.00	$45.00	$48.00
Seattle	.....	19.52	.....	.....	23.00
New Orleans, at mill	70.00	.....	.....	37.00	.....
Baltimore	35.00	.....	.....	36.45	.....
Cincinnati	62.50	80.00	.....	33.50	.....
Montreal	39.50	48.00	35.00	80.00	45.00
Los Angeles	.....	37.00	36.00	.....	43.00
Denver	.....	35.25	35.25	.....	33.75
Minneapolis	44.50	37.25	36.25	40.75	38.25
Atlanta	21 00	.....	.....	24.00	.....
Dallas	37.50	30.00	.....	48.50	.....
Kansas City	35.00	34.50	.....	20.00	31.00
Birmingham	22 00	.....	.....	24.00	.....
Philadelphia	29.50*	37.00	43.00	32.50	37.50
Detroit	42.75	35.00	.....	40.25	38.75
St. Louis	36.00	.....	.....	35.00	.....

Montreal—Up to 32 ft.; over which, $3.00 per M. increase up to 30 ft.

Birmingham—Quotes carload lots, f.o.b. sidings. $2.00 additional per M. ft. to contractor.

Boston and Cincinnati—Prices to contractors in carload lots, f.o.b.

Denver—Quotes dealers prices to contractor on large projects.

St. Louis—Wholesale price to contractors, $4.50@$6 per M ft. additional.

FREIGHT RATES

On finished steel products in the Pittsburgh district, including plates, structural shapes, merchant steel, bars, pipe fittings, plain and galvanized wire nails, rivets, spikes, bolts, flat sheets (except planished), chains, etc., the following freight rates are effective in cents per 100 lb., in carloads of 36,000 lb.:

Baltimore	$0.31	Detroit	$0.28
Birmingham	.66	Kansas City	.70
Boston	.35	New Orleans	.44½
Buffalo	.25½	New York	.33
Chicago	.33	Pacific Coast (all rail)	1.43†
Cincinnati	.28	Philadelphia	.31
Cleveland	.21	St. Louis	.41
Denver	1.14*	St. Paul	.57

* Minimum carload, 40,000 lb.

†Minimum carload, 50,000 lb., structural steel only; 80,000, lb. for other iron or steel products.

CONTRACTORS' SUPPLIES

STEEL SHEETPILING—The following price is base per 100 lb. f. o. b. Pittsburgh, with a comparison of a month and a year ago:

Current	One Month Ago	One Year Ago
$2.00	$2.00	$2.55

WIRE ROPE—Discounts from list price on regular grades of bright and galvanized are as follows:

	Eastern Territory New York and East of Missouri River
Hercules red strand, all constructions	30%
Patent flattened strand, special and cast steel	30%
Patent flattened strand, iron rope	15%
Plow steel round strand rope	45%
Special steel round strand rope	40%
Cast steel round strand rope	32½%
Round strand iron and iron tiller	15%
Galvanized steel rigging and guy rope	17½%
Galvanized iron rigging and guy rope	+2½%

California, Oregon, Nevada and Washington Discount 5 points less than discount for Eastern territory.

Wyoming, New Mexico and Colorado: Discount 5 points less than discount for Eastern territory.

Arizona: Discount 10 points less than discount for Eastern territory.

Montana, Idaho and Utah: Discount 10 points less than discount for Eastern territory.

North Dakota, Nebraska, Kansas, Oklahoma and Texas: Discount 5 points less than discount for Eastern territory.

MANILA ROPE—For rope smaller than ¾-in. the price is ½ to 2c. extra; while for quantities amounting to less than 600 ft., there is an extra charge of 1c. The number of feet per pound for the various sizes is as follows: ¼-in., 8 ft., ⅜-in., 6; ½-in., 4½; ⅝-in., 3½; ¾-in., 2 ft. 10 in.; 1-in., 2 ft. 4 in. Following is price per pound for ¾-in. and larger, in 1200-ft. coils:

Boston	$0.20	New Orleans	$0.17½
New York	.17	Los Angeles	.16½
Chicago	.19	Seattle	.18
Minneapolis	.19½	St. Louis	.21
San Francisco	.17	Montreal	.30
Atlanta	.21	Detroit	.19
Denver	.20	Baltimore	.20
Cincinnati	.20	Kansas City	.18½
Dallas	.29	Birmingham	.20½
Philadelphia	.18		

EXPLOSIVES—Price per pound of dynamite in small lots:

	Gelatin 40%	Gelatin 60%
New York	$0.2950	$0.3250
Boston	.24	.275
Kansas City	.24	.2750
Seattle	.1775	.1975
Chicago	.2450	.2750
Minneapolis	.2144	.2347
St. Louis	.2475	.2775
Denver	.2250	.2550
Dallas	.29	.375
Los Angeles	.23	.26
Atlanta	.2575	.2875
Baltimore	.2550	.27
Cincinnati	.2350	.255
Montreal	.215	.255
Birmingham, *delivered*	.155	.175
New Orleans	.2725	.3075
San Francisco	.195	.235
Philadelphia	.24	.27

PILES—Prices per lineal foot, pine piles with bark on, f.o.b. New York.

Diameters	Points	Length	Barge	Rail
12 in. at butt	6 in.	30 to 50 ft.	$0.13	$0.17½
12 in.—2 ft. from butt	6 in.	50 to 59 ft.	0.17½	0.22
12 in.—2 ft. from butt	6 in.	60 to 69 ft.	0.19½	0.24
14 in.—2 ft. from butt	6 in.	50 to 69 ft.	0.23	0.32
14 in.—2 ft. from butt	6 in.	70 to 79 ft.	0.25	0.34
14 in.—2 ft. from butt	5 in.	80 to 89 ft.	0.32	0.38

SCRAP—The prices following are per gross ton paid to dealers and producers f.o.b. New York. In Chicago and St. Louis the quotations are per net ton and cover delivery at the buyer's works, including freight transfer charges.

	New York	Chicago	St. Louis
No. 1 railroad wrought	$11.50	$11.50	$12.00
Stove plate	12.50	12.00	13.50
No. 1 machinery cast	17.00	16.50	14.50
Machine shop turnings	7.00@7.50	4.00	5.00
Cast borings	7.00@10.00	5.50	6.75
Railroad malleable cast	11.00	12.50	10.25
Re-rolling rails	11.50@12.00	13.00	15.00
Relaying rails	28.50	30.00	15.00

SHIP SPIKES—Current prices per 100 lb.:

In	San Francisco Galv.	San Francisco Black	Seattle Black
½	$6.75	$5.50	$8.55
⅝	6.30	5.05	8.25
¾	6.15	4.90	8.30

Pittsburgh base in lots of 200 kegs or more $2.50